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THE USE OF LIME ON NEW ZEALAND PASTURES.*

J. W. WOODCOCK, Crop Experimentalist.

INTRODUCTION.

IN this paper the word "lime" is restricted in its application to burnt lime, slaked lime, and ground limestone, and does not include other calcium compounds such as phosphate or nitrate, which are applied on account of a direct manurial value. Further, any reference to the beneficial action of liming is made on the assumption that its use coincides with or is followed by applications of phosphate, and at the outset it should be emphasized that the use of lime without phosphate is not generally advocated.

THE EXTENT OF LIMING.

The use of lime in New Zealand is increasing rapidly, and the total quantity of "agricultural lime" transported by rail in the year ending 31st March, 1935, was nearly 245,000 tons. This quantity was approximately double that carried in 1927-28.

A comparison of figures relating to the areas top-dressed and limed in each land district with the quantities of lime carried by rail indicates that Otago and Southland are by far the greatest users of lime in proportion to the amount of grassland top-dressed. It is also indicated that in these districts there is a tendency to apply lime in large quantities of from 10 cwt. to 1 ton per acre as opposed to smaller quantities of from 3 cwt. to 7 cwt. per acre applied in the more northerly land districts. Of the latter, Canterbury, Westland, and Auckland rank highest as regards the quantities of lime used, while in Gisborne, Hawke's Bay, and Marlborough respectively the proportion of grassland limed is less than 20 per cent. of that top-dressed.

While there has been no definite trend during recent years in the South Island, there has been a general increase each year since 1927-28 in the North Island, and here the quantity transported by rail last season was four times that carried in the season mentioned above.

* Substance of paper presented at Fourth Conference of the New Zealand Grassland Association, Christchurch, August, 1935.

Reasons for Use of Lime.

In 1931 Connell(1) drew attention to the rapidly increasing quantities of lime used, and suggested that lowering of expenditure in a time of financial stress was the cause which led to some of the increase. Although the diminution in the quantities of fertilizers used during the period cited lends support to this hypothesis, it should be borne in mind that certain published reports(2), (3), (7) on the effect of lime may also have had some influence. It is true that the reports which gave prominence to the visible effect of lime concerned the South Island, but other, and probably far more telling, aspects of the use of lime in the North Island concerned the mineral-content of the herbage and the effect of lime deficiency on the health of stock—a factor quite as potent in some districts as increased production.

The underlying factor behind the use of lime on many farms is the belief that it not only possesses a subtle influence on the chemical composition of the herbage, but also reduces the soil acidity. The cheapness of the material, often as low as 10s. per ton, is a further inducement to apply lime, and the fact that the Government encourages its wholesale use by giving free railage up to 100 miles still further develops a lime " complex " in the mind of the New Zealand farmer.

Actually, New Zealand farmers, apart from those in one or two districts, have less incentive to lime than farmers in the Northern Hemisphere. " Mat " on grassland, a condition requiring a large application of burnt lime for its eradication, is comparatively unknown in the Dominion. Although clovers are generally stimulated by applications of lime in New Zealand, in some districts they thrive on soils having a lime-requirement much greater than that tolerated by clovers in Europe. In other countries much stress is placed on the suppression of beneficial soil bacteria under acid conditions, and the absence of *Azotobact.r* in particular is generally viewed with much concern. In an examination of fifteen New Zealand soils in connection with the " soil plaque " method of soil analysis Reid(4) found *Azotobacter* spp. to be normally present in only one sample (pH 7·5), so that apparently *Azotobacter* is not well distributed in our soils, although nitrogen fixation does not seem to suffer on that account. Scrivener(5) remarked on the apparent failure of existing methods of determining lime-requirement under New Zealand conditions, but later(6) suggested a modified formula which, when applied to certain soil-tests, appeared to correlate these with responses in the field.

The fact remains that in New Zealand we cannot be guided by many of the theoretical considerations, laboratory procedure, or ecological conditions governing lime and its use in other countries. Our only guide to date has been actual field trials carried out either by the farmer or by the State.

Field Trials.

The Fields Division of the Department of Agriculture has conducted throughout New Zealand since 1924 approximately 600 simple observational trials in which lime plots (chiefly calcium carbonate) were included. Generally lime alone was compared with no lime, and

fertilizers—chiefly superphosphate and potash—with lime were compared with the same fertilizers on unlimed ground. Most of the results have been published(7), and are here summarized briefly.

In some of the experiments marked responses occurred, in others little or no visible benefit was derived either from lime alone or lime in combination with phosphates.

As superphosphate has been used in practically all these trials, the effect of lime might be considered relative to that of superphosphate in the following groups :—

1. Superphosphate alone gives poor or only fair results ; lime alone may give fair to good results, superphosphate with lime gives good to very good results.

Growth of both grasses and clovers is poor on unlimed ground, but lime in conjunction with superphosphate induces a striking improvement in white clover, which is often reflected in the health and vigour of the rye-grass. The palatability of the limed plots is generally better, as shown in the grazing. Liming is essential on this class of land, although in some cases it is quite possible that basic slag used repeatedly might obviate the necessity of liming. This is open to question, however, in districts where lime responses of such magnitude occur, since, in the majority of cases where basic-slag plots were included, liming improved the appearance of the latter as well as of the superphosphate plots.

The proportion of experiments falling in this group, together with the districts in which the responses occurred, are as follow :—

District.	Soils.	Percentage of Experiments in Group 1.
North Auckland ..	Clays or silts	92
North Auckland ..	Ironstone (laterite) .	100 (2 experiments).
North Auckland ..	Volcanic	71
Marlborough	Loams and sandy loams ..	33
Westland	Miscellaneous	90
North Canterbury ..	Silt loams and loams ..	43
Christchurch	Sandy silts, silt loams ..	41
Mid-Canterbury ..	Fine sandy silts, silt loams ..	61
South Canterbury ..	Clay loams, silt loams ..	30
South Otago	Miscellaneous	33
East Southland ..	Miscellaneous	60
West Southland ..	Miscellaneous	11
Nelson	..	Pakihi lands.

The small proportion of experiments showing relatively good responses from superphosphate plus lime as compared with superphosphate in South Otago and Western Southland—districts in which lime is used freely and in large quantities—may be due to the fact that sufficient lime had already been applied. It should be stated that the fertilizers and lime were top-dressed on existing pasture, and that in the two districts last mentioned the general farming practice is to sow down to grass with 1 ton per acre of carbonate of lime.

In the above group might be included a trial at Ruakura Farm of Instruction under the mowing-and-grazing technique evolved by

Hudson. This experiment was laid down in July, 1934, on newly-sown pasture, and the soil may be roughly described as a peat loam. Results to 19th June, 1935—*i.e.*, for approximately ten months—are markedly in favour of the lime treatments, as indicated by the following :—

Treatment.	Relative Production of Dry Matter. (No Manure = 100.)
No manure	100
Superphosphate, 4 cwt. per annum	116
Superphosphate, 4 cwt. per annum plus lime, 1 ton (initial)	137
Superphosphate, 4 cwt. per annum plus lime, 10 cwt. (initial)	130

It is interesting to record that an observational trial on a true peat soil at Ruakura suggests results in accord with the above.

2. *Superphosphate gives good results, but better results are obtained from superphosphate with lime.*

In the trials of this group the lime responses are generally spasmodic —*i.e.*, they are obvious only at certain times of the year, and then chiefly in the autumn, when white-clover growth is more pronounced. Moreover, the experiments are, in most cases, on better pastures than those in Group 1. It is indicated in these experiments that lime is not essential for the establishment and maintenance of reasonable pasture, but that lime as an adjunct to superphosphate increases production. It does not necessarily follow that the use of lime under these conditions is profitable, since it might be found that money spent in extra phosphate rather than in liming gives greater returns. Further, basic slag, under certain conditions, may be a better proposition than superphosphate plus lime.

Experimental results falling in Group 2 have been obtained in most districts throughout the Dominion, but more especially in the King-country, South Taranaki, Wanganui, Marton, Wairarapa, and Northern Manawatu districts of the North Island and Banks Peninsula in the South Island, in addition to those districts mentioned under Group 1.

In the category of Group 2 may be placed a trial under the mowing and grazing technique at Marton Experimental Area. This trial was laid down in September, 1932, and results up to 21st June, 1935, after approximately two years nine months of trial, show the following :—

Treatment.	Relative Production of Dry Matter.
No lime	100
Carbonate of lime, 2 tons per acre (initial).. ..	112·5
Carbonate of lime, 1 ton per acre (initial)	107·9

Although in this trial there is no comparison of superphosphate with no manure, other experiments on the farm show responses from superphosphate which can be classified as good.

3. *The addition of lime to superphosphate causes no appreciable improvement.*

Although isolated trials in the undermentioned districts may show slight but fleeting responses from lime, the majority of the experiments do not indicate any improvement in the amount of growth, composition

of sward, or palatability of herbage. In fact, the limed plots have, on occasion, been inferior in general vigour of herbage in some of the experiments.

Districts in which no general apparent benefit has been derived from lime used in experiments are—Rotorua and Southern Waikato (pumice soils), Hauraki Plains (clay soils), Southern Poverty Bay, Hawke's Bay, Southern Manawatu, North Otago, and Central Otago.

HAYING TRIALS.

During the seasons 1924 to 1929 a large number of experiments were carried out in which the production of herbage from various treatments, including lime, was cut and weighed as for a hay crop. Only seventeen experiments out of forty-six, or 37 per cent., of the trials gave any appreciable increase in bulk from the lime plus superphosphate plots as compared with superphosphate alone. Most of the experiments referred to were in the South Island and in districts in which subsequent observational trials indicated that liming caused appreciable benefit. The weakness of trials in which hay-weights are the sole criterion of improvement is in the fact that the hay crop represents only a portion of the growth for the whole year, and, further, that any increases due to a particular treatment are obtained during the period of maximum production. Since, as will be shown later, lime tends to increase production most during periods of low production, it is considered that the results of haying trials might even be misleading when the effects of liming are under investigation.

THE EFFECT OF LIME AT VARIOUS TIMES OF THE YEAR.

In the liming trial at Marton referred to previously, one of the most marked features in the increased production from liming (all plots being phosphated) was the relatively high response during periods of low production, particularly in the dry months of the late summer and in autumn, and the relatively low response during periods of high grassland production. In connection with the foregoing statement regarding hay-weights, the increases due to the application of 2 tons per acre of lime in the "haying period" (taken as from 1st October to 31st December) as compared with the remainder of the year are as follow :—

	Percentage Increases of Lime over No Lime : Dry Matter. Per Cent.
"Haying period," 1932–33	9·2
Remainder of year 1933	16·6
"Haying period," 1933–34	11·6
Remainder of year 1934	24·1
"Haying period," 1934–35	1·4
January to June, 1935	9·3

The results of this trial show, incidentally, that even where lime gives a moderate response the effect at times is apparent very soon after application. It is of interest that in another experiment alongside the above, basic slag is giving results slightly inferior to those from superphosphate, and the addition of lime to basic slag has given a slight increase over basic slag without lime.

LIME-CONTENT OF HERBAGE.

As the herbage from the above trial was analysed periodically it is possible to ascertain whether or not liming affected the lime-content of the herbage. For the first eight months of the trial the lime (CaO) content of the herbage from the no-lime plots averaged 1·15 per cent. of the total dry matter, while on the limed (1 ton carbonate per acre) plots the CaO content was 1·24 per cent.*

In view of the fact that the herbage from the limed plots contained a greater proportion of white clover, which, according to Doak(8), contains almost twice as much lime (CaO) as rye-grass, the increased CaO content of the herbage due to liming is not unexpected. In discussing the effect of superphosphate on the chemical composition of herbage, Hudson and Doak(9) stated " It should be remembered that the increased lime-content is not wholly due to an increased percentage of clover in the mown herbage, but is partly due to an increased percentage of lime in both the grass and the clover."

This lends support to the hypothesis that liming increases the CaO content of the herbage, apart from the change in botanical composition, just as potash applications in another trial(10) increased the potash (K_2O) content of herbage without changing the sward or even increasing yield to any appreciable extent.

THE DURATION OF EFFECT OF LIMING.

The effect of lime is said to persist for many years, particularly on grassland. This idea is so well established in Great Britain that in some districts an ingoing tenant must pay an outgoing tenant one-eighth of the cost of lime applied seven years previously on the assumption that the effect of lime on grassland lasts for eight years after application. As the leaching of lime from the soil depends to a large extent on rainfall, one expects the lime to be effective for a considerably less period in wet districts, particularly where the soil is of a light, porous nature. At Marton, in the liming experiment referred to previously, records of the free calcium carbonate ($CaCO_3$) in the top two inches of soil suggest that the latter is lost readily from this horizon, only about half of the $CaCO_3$ applied being recoverable after the first year. Since calcium compounds have so many functions in the soil —*e.g.*, preservation of soluble phosphate subsequent to superphosphate applications, the alleged liberation of phosphates and potash which are not immediately available to the plant, and the effect on the mechanical condition of the soil, in addition to the reduction of soil acidity—it appears that the only satisfactory method of gauging loss of lime from the soil is from actual drainage determinations. The term of years over which lime is effective depends considerably upon the initial effect on the pasture. In several of the observational trials laid down in Canterbury the effect of 1 ton of lime applied in 1928 was clearly visible in 1935—seven years after application. At Winton Experimental Farm lime applied at a ton per acre across several paddocks in 1924 was clearly visible up to a year ago in the general improved vigour of various crops sown, particularly turnips. In this case the effect of lime was not apparent until about two years after application. It is hoped that

* Figures kindly supplied by Mr. B. W. Doak.

some exact information as to the duration of the response to liming may be obtained from experiments under mowing and grazing at Marton and Ruakura.

FORMS OF LIME.

There does not appear to be any advantage in using burnt lime on grassland as opposed to carbonate. Burnt or slaked lime is recommended for certain purposes on arable crops—*e.g.*, club-root control—but in view of the extra cost entailed by burning, carbonate of lime is more economical on grassland, and experimental evidence to date indicates it is quite as efficient as burnt lime when an equivalent amount of CaO is applied in each case.

AVAILABILITY OF CARBONATE OF LIME.

Much has been said regarding the extent to which limestone should be ground. In the United States of America particularly there seems to be considerable divergence of opinion as to the best degree of fineness commensurate with cost of grinding. Grimmett and Denz(11) reviewed the question of fineness of grinding and other factors relating to availability in New Zealand.

Some time ago the writer and others(12) investigated the effect of various commercial samples of carbonate of lime in alleviating the germination-injury to turnip-seed caused by superphosphate. It was found that whereas many brands were fairly efficient in this respect a few were extremely poor, notwithstanding the fact that they contained a high percentage of calcium carbonate. Fineness of grinding was found to be of importance, although when each of the limestones used was reduced to a fairly high degree of fineness there still remained appreciable differences in performance which could not be explained by variations in the calcium carbonate content or the hardness of the parent rock. The trials focussed attention on the very considerable differences in the degree of fineness of ground limestones turned out by various quarries. Over 40 per cent. of some samples is retained on a 30-mesh sieve—which is a relatively coarse grade—while others can produce the material with less than 20 per cent. retained on a 30-mesh sieve. At the other end of the scale some commercial samples contain about 50 per cent. of material passing a 120-mesh sieve, and these can be purchased at less cost than others containing only about 15 per cent. of this fine fraction.

The question arises, are these differences in fineness of any real moment, since it is likely that the coarser particles become available ultimately under the action of rainfall and weathering over a period of years? It has been suggested in some quarters that a fair proportion of coarser material may actually be an advantage since less leaching of lime is likely to occur. On the other hand, money spent on coarsely ground limestone represents capital lying idle for a number of years, and the modern farmer tends to depart from the old established custom of manuring for posterity. Quick returns from any operation are now looked for, and it is suggested that just as one applies quickly acting fertilizers to obtain a large initial response, so should frequent applications of finely ground limestone be made rather than infrequent dressings of relatively coarse material.

Conclusion.

The present paper is a brief survey of the practice of liming on New Zealand grasslands. It has been indicated from the results of observational trials on grassland that liming increases the efficiency of phosphates, particularly superphosphate, over wide areas of New Zealand. The resultant increased production is obtained chiefly during a period of normally low production, and, where effective, is therefore another of the means of getting a more even distribution of production over the year.

The effect of lime on pasture has been found to persist for several years in some districts in spite of the frequently made assertions that calcium carbonate is leached rapidly from the soil.

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SEEDLESS BARBERRY IN SOUTHLAND.

Relative to the statement about the use of seedless barberry in Southland which appeared in the September number of this *Journal*, page 190, a correspondent at Otara has kindly supplied the appended information:—

"About ten or twelve years ago, perhaps more, I obtained cuttings of this plant from Matamata, Waikato, and had no difficulty in getting them to grow, but have found them to be very slow to develop, and the change of climate seems to have held them back so much that I have not considered them at all profitable for hedge-work here at Woodlands. Further, contrary to the northern experience, I have found that stock particularly relish the young shoots, perhaps because of our later spring and scarcity of green feed in the time the young shoots are available. Plants I have within reach of stock are well kept back because of this, and are still very small, while a sheltered plant is now 7 ft. or 8 ft. high, and I have been watching to see if it will improve its growth with time in the South.

"Some plants I gave to a relative on the Taieri Plain, planted on heavier land than mine, did not show material difference in results.

"Summed up, I would say that the growth has been too slow, and that the need of fencing has so far ruled seedless barberry out as a profitable fence for my use."

THE OCCURRENCE OF SPOTTED-WILT ON TOMATOES IN NEW ZEALAND.

E. E. CHAMBERLAIN and G. G. TAYLOR, Mycological Laboratory, Plant Research Station, Palmerston North.

THE name "spotted-wilt" was first used by Brittlebank (1919) in Australia to describe a disease of tomatoes observed near Melbourne during the 1915–16 season. This disease, which has since been shown to be caused by a virus (Pittman, 1927), has been studied in detail by Samuel, Bald, and Pittman (1930) and Bald and Samuel (1931). Spotted-wilt has been recorded also from England (Smith, 1931; Ainsworth, 1933) and from North America (Doolittle and Sumner, 1931; McWhorter, 1934).

For a number of years a serious disease, known locally as "stripe" or "brown-top," the symptoms of which closely resemble those of spotted-wilt, has been present in tomato crops grown in the Hutt Valley, New Zealand. During the 1934–35 season it has made its appearance in the Manawatu district.

SYMPTOMS.

On out-door tomatoes the first noticeable symptom of the disease is a slightly bunched appearance of the growing-points (Figs. 1 and 2). This appearance is caused by cessation of growth, downward curling of the developing leaves, and inrolling of the individual leaflets. At this stage the older leaves appear normal, but on the young leaves bronze markings are apparent, and these form the most characteristic symptom of the disease. The leaf markings may vary in colour from light bronze to almost black. They may occur as small isolated areas, which in some cases have a concentric ringed appearance of light and dark tissue, or as an irregular patchwork of bronzed tissue which either follows the veins or is spread over the leaf surface (Fig. 3). In some instances bronzing is diffuse with no delimitation of particular areas. As a rule the markings are more pronounced on the basal leaflets of the compound leaves and on the basal portions of the individual leaflets (Fig. 3). At first bronzing is more apparent on the upper leaf surfaces, but as the disease develops it becomes marked also on the undersides. Still later the affected areas die, causing the leaves to become brown and withered. Markings also make their appearance on the stems and leaf petioles, where they occur as isolated patches or streaks. After a few weeks the diseased plants appear markedly stunted in contrast to healthy plants (Fig. 4).

Infection occurs at all stages of growth, but the older the plants are at the time of infection the less marked are the symptoms. In very young plants bronzing is often followed by shrivelling of leaves and death of the plants. Older plants usually remain alive in a stunted condition for several months. Under certain conditions such plants produce weak shoots, which appear to be healthy, although at times

FIG. 1. TOMATO-PLANT NATURALLY INFECTED WITH SPOTTED-WILT.

An early stage of the disease, showing the bunched appearance of the growing points.

[*Photo by H. Drake.*

FIG. 2. SPOTTED-WILT SYMPTOMS ON ARTIFICIALLY INOCULATED TOMATO-PLANT.

On left uninoculated plant of same age.

[*Photo by H. Drake.*

the foliage shows mottling similar to that present on mosaic-infected plants. Eventually bronzing appears, and growth again ceases. On plants which are nearing maturity at the time of infection leaf symptoms are slight or entirely absent. The fruit on such plants usually develops normally, but occasionally in the early part of the season bronzing and distortion of the fruit occurs. The fruit may even ripen without showing symptoms, but usually the presence of the

FIG. 3. BRONZE MARKINGS ON LEAF FROM A TOMATO-PLANT NATURALLY INFECTED WITH SPOTTED-WILT.

[*Photo by H. Drake.*

disease becomes evident by the appearance of light-red, yellow, or almost white patches, which contrast with the bright red of the ripe fruit. The discoloured patches may occur as isolated circular areas, as concentric circles, or as confluent patches covering a considerable surface of the fruit (Fig. 5). Discoloration usually penetrates some distance below the surface, but does not appear to affect the quality or flavour of the fruit. On account of its mottled appearance, however, such fruit is not marketable.

Economic Importance.

Plants infected in the early stages of growth either die or remain very stunted, and thus produce no fruit. Those infected at a later stage may develop fruit which is in some instances marketable, but usually is rendered unsaleable by discoloured areas.

Losses, which are practically confined to the field crops, are greatest in the Hutt Valley. Under the conditions existing there little infection occurs early in the season, and it is only in the mid-season and late crops that a high percentage of the plants become infected. Fifty-per-cent. infection has been observed in mid-season crops, and in some instances growers claim that their late crops have produced no

FIG. 4. STUNTING OF TOMATO-PLANTS CAUSED BY SPOTTED-WILT.
[*Photo by H. Drake.*

marketable fruit. Losses are greater in some years than in others, and the percentage infection varies from one crop to the next. Surveys made during the 1933–34 and 1934–35 seasons of numerous tomato gardens throughout the Hutt Valley failed to disclose a single crop free from the disease.

Identity of the Disease.

An investigation of the disease was commenced during the 1933–34 season. Since the symptoms appeared to be identical with those of spotted-wilt, experiments were carried out to determine whether, in common with spotted-wilt, it (1) was of a virus nature, (2) was able to infect tobacco, (3) produced local lesions on tobacco, and (4) was similarly short-lived in extracted juice.

(1) *Virus Nature.*—The virus nature of a disease may be proved by reproducing the symptoms on healthy plants either (i) by transference of insects which have fed on an infected plant, or (ii) by artificial inoculation with juice extracted from diseased material. In the present instance artificial inoculations alone were carried out.

EXPERIMENTAL METHOD.

Tomato-plants were raised in an insect-free glasshouse and transplanted into 6 in. pots. In most cases the plants remained in an insect-free house throughout the duration of the experiment, but in

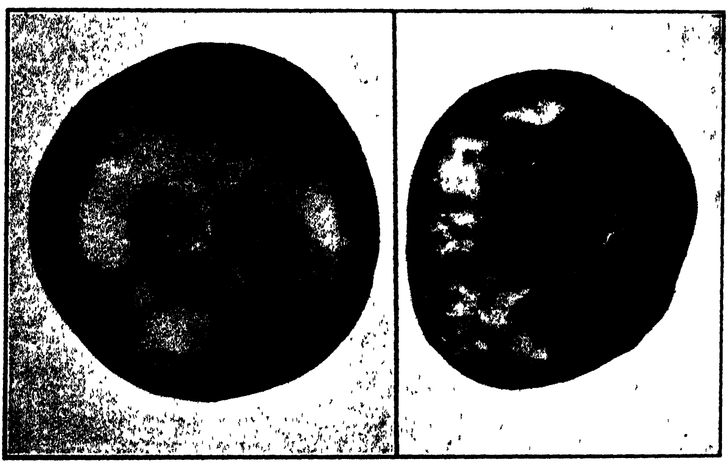

FIG. 5. MARKINGS, CAUSED BY SPOTTED-WILT, ON RIPE TOMATO FRUIT.

[*Photo by H. Drake.*

several instances they were removed from the glasshouse to harden off before they were inoculated and remained in the open until symptoms appeared.

Juice extracted by grinding in a mortar leaves taken from a recently infected plant was used as an inoculum. This inoculum, undiluted or reduced to half strength with distilled water, was applied to healthy plants within twenty minutes of extraction. Six to twelve leaflets of each plant were inoculated by the " leaf-rubbing " method evolved by Holmes (1929A), muslin moistened in the inoculum and stretched over the forefinger being used in the manner described by Bald and Samuel (1931).

RESULTS.

The results of a number of experiments in which the disease was transmitted by artificial inoculations are shown in Section A, Table I. From these it is apparent that the disease is of a virus nature.

Table I.—Transmission of the Disease by Means of Artificial Inoculations.

Experiment No.	Date of Inoculation.	Source of Inoculum.	Number of Plants.	Number of Plants infected.	Incubation Period.*
		A.—TOMATO TO TOMATO.			
1	11/12/33	Field, Lower Hutt† ..	12	4	Not observed.
		Check	12	0	..
2	23/1/34	Plant × experiment 1 ..	12	11	15 days.
		Check	6	0	..
3	23/2/34	Field, Lower Hutt ..	7	5	15 days.
		Check	7	0	..
4	11/12/34	Field, Lower Hutt ..	6	6	10 days
		Check	6	0	..
5	19/12/34	Field, Palmerston North	5	3	Not observed.
		Check	5	0	..
6	30/12/34	Plant × experiment 4 ..	5	5	20 days.
		Check	2	0	..
7	11/1/35	Field, Lower Hutt ..	6	6	20 days.
		Check	6	0	..
8	23/2/35	Field, Lower Hutt ..	18	8	15 days
		Check	9	0	..
9	10/3/35	Plant × experiment 8 ..	4	3	12 days
		Check	4	0	..
	Total inoculated plants		75	51	..
	Total check plants		57	0	..
		B.—TOMATO TO TOBACCO			
1‡	23/2/34	Field, Lower Hutt ..	4	2	19 days
		Check	4	0	..
2‡	23/2/34	Field, Lower Hutt ..	16	7	12 days
		Check	8	0	..
3	10/12/34	Field, Palmerston North	6	1	24 days.
		Check	6	0	..
4	11/12/34	Field, Lower Hutt ..	6	2	23 days
		Check	6	0	..
	Total inoculated plants		32	12	..
	Total check plants		24	0	..

* It was not always possible to make daily observations of the plants, so that in some cases the incubation period may have been one or two days shorter than that recorded in the table.

† "Field, Lower Hutt," indicates that naturally infected plants collected in the field at Lower Hutt were used as source of inoculum.

‡ The source of inoculum for these two experiments was the same, but inoculated plants of experiment 1 were older than those of experiment 2.

The symptoms of the disease under glasshouse conditions are different in certain respects from those occurring in the field. Plants grown in 6 in. pots in the glasshouse are not so vigorous as those in the field, and this appears to affect the symptoms. The typical downward curling of the leaves and the "bunchy

top" appearance are not so marked. Infected plants become severely stunted and the foliage turns yellow. Characteristic leaf markings appear, but as a rule are not very extensive. By inoculating plants grown in 8 in. pots and supplied with artificial manure it was possible to produce symptoms more typical of those occurring in the field (Fig. 2).

(2) *Transmission to Tobacco.*—When inoculating tobacco the same method was used as for tomatoes, juice extract from infected tomatoes being applied to two or three leaves of each plant. The results of the cross-inoculation experiments are given in section B of Table I. It is evident from these results that the disease is readily transmitted to tobacco.

The symptoms on tobacco-plants grown in the glasshouse are as follows: Within four to eight days of inoculation isolated, roughly circular necrotic areas appear on the inoculated leaves. These, later referred to as local lesions, usually

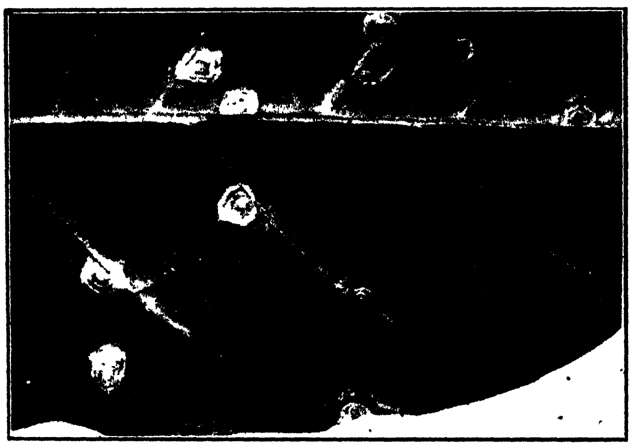

FIG. 6. LOCAL LESIONS OF SPOTTED-WILT ON TOBACCO.

Leaf artificially inoculated by rubbing with juice from an infected tomato-plant. [*Photo by H. Drake.*

have a concentric ringed appearance (Fig. 6). They are followed in from seven to fourteen days by the secondary symptoms of the disease. On small plants still in the rosette stage all the leaves wilt, and death of the plant quickly follows. On older plants a black streak appears upon one side of the stem and the top bends over (Fig. 7). The young leaves wilt and die, and dark necrotic areas, following along the veins, appear on the older leaves. All growth ceases.

(3) *Formation of Local Lesions.*—Holmes (1929B) in carrying out artificial inoculations discovered that tobacco mosaic produced on certain hosts necrotic local lesions at the points where the virus successfully penetrated the leaf tissues. Lesions of this nature are produced only by certain viruses and only on certain hosts. They are of definite types (Samuel, 1931), and may be used, therefore, as an aid in classifying viruses.

In the above-mentioned cross-inoculation experiments, in all cases where the disease was successfully transmitted to tobacco secondary symptoms were preceded by local lesions. These lesions (Fig. 6) appeared to be identical with local lesions of spotted-wilt on tobacco, as described by Samuel and Bald (1933A).

(4) *Longevity of the Virus.*—Viruses are able to grow and multiply only within living cells, but remain viable in extracted juice for varying lengths of time. The longevity in the juice is a constant character of a virus, and is therefore of diagnostic value. It has been shown by Samuel and Bald (1933B) that longevity, or rate of ageing, of a virus may be determined by the use of local lesions, and this method has been employed in the present instance.

FIG. 7. SPOTTED-WILT SYMPTOMS ON AN ARTIFICIALLY INOCULATED TOBACCO-PLANT.

Plants grown in glasshouse. On right uninoculated plant of same age.

[*Photo by H. Drake.*

EXPERIMENTAL METHOD.

The plants were inoculated by drawing firmly over the leaf surface a glass spatula moistened with the extracted juice, according to the method outlined by Samuel and Bald (1933B). To obtain direct comparisons one-half of a leaf was inoculated with juice extract of one age and the other half with juice extract of a different age. Four half-leaves on each plant were inoculated.

The results are given in the following table:—

Table II.—Longevity of the Virus in Extracted Juice

Age of Juice Extract.	0–15 Minutes.	30–45 Minutes.	90–105 Minutes.	150–165 Minutes.
Number of local lesions* ..	165	16	0	0

* Each figure represents the total number of lesions which developed on twenty half-leaves.

The results are very similar to those obtained by Samuel and Bald (1933B) for spotted-wilt on tobacco, and from them it is apparent that the virus causing the disease lives for a short time only when removed from the living tissues.

A consideration of the above experiments shows that, in all the characters tested, the New Zealand disease is similar to tomato spotted-wilt of Australia.

SUMMARY.

(1) A serious disease of tomatoes has been present for a number of years in the Hutt Valley, and recently has appeared in the Manawatu district.

(2) A description of the symptoms of the disease is given.

(3) The disease, which may cause a total loss of infected plants, has occurred to the extent of 100 per cent. in some of the late-season tomato crops grown in the Hutt Valley.

(4) The symptoms, virus nature, transmissibility between tomato and tobacco, formation of local lesions on tobacco, and the short life of the virus in the extracted juice all indicate that the disease is identical with the Australian form of tomato spotted-wilt.

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The Fields Instructor, Christchurch, reports that a good response to basic slag has occurred on both limed and unlimed plots at Robinson's Bay, Banks Peninsula.

WINTON EXPERIMENTAL AND DEMONSTRATION FARM.

RECORD OF WORK FOR SEASON 1934-35.

A. STUART, Instructor in Agriculture.

THE season under review was not altogether a favourable one in that a fairly dry summer followed a wet spring, and although good rains fell in January and again in April pasture-growth for the season was below normal, and supplementary fodder crops, while yielding well, were not as succulent or nutritive, being affected by the unusual growing-conditions experienced.

In pursuance of the committee's policy of diversifying the farming operations the dairy herd was reduced, thirteen cows being disposed of. Unfortunately these cows were not strictly culls, but were empty cows, and in any case could not have been retained. For the season some 6,959 lb. of butterfat were actally sold from the thirty-six cows milked, compared with 10,682 lb. from forty-five cows the previous season.

A flock of one hundred breeding-ewes was purchased early in the season, together with some sixty hoggets. One hundred and forty-four fat lambs were disposed of at the end of the season, this total including a line of twenty-seven bought as store lambs. The hoggets were disposed of at a profit, and in the autumn the ewe-flock was culled, being again replaced later in the season.

Fifty-one head of cattle and eighty-nine sheep, comprised as follows thirty-five cows and heifers, twelve yearlings, one bull, three horses, two rams, and eighty-seven ewes, were wintered on the farm of 96 acres. A line of sixty hoggets was purchased early in the spring, and the committee sold the "tops" of 5 acres of swedes in May and ½ acre of swedes were sold in August for feeding-off. Each season approximately 20 acres is under the plough, and this season was no exception, about 5 acres of each of the following crops being grown: Chou moellier, turnips and swedes, and a similar area was sown down with oats and grass.

CARRYING-CAPACITY TRIAL.

This trial was laid down last season in field 6 to determine the relative carrying-capacity and production of certified versus uncertified rye-grass.

One-half (6A) was sown with certified rye-grass, and the other (6B) with a blend of five uncertified lines of rye-grass. An uncertified white-clover strain was included in both, which were sown with oats as a nurse crop.

Although the first autumn grazing resulted in favour of the uncertified blend, this was counterbalanced early in the spring by the certified line, and at the finish of the season the certified rye-grass had established a lead of 73·8 cow-days per acre and 71·75 lb. of butterfat per acre.

GRASS AND CLOVER STRAIN TRIALS.

At each end of field 9 grass and clover demonstration plots were laid down in November. These represent some thirty-six different seed mixtures, and a fairly comprehensive manurial trial is also included. It is intended to hay one trial every year, while the other will be intermittently grazed. In this way the effects of management on pastures may be demonstrated. The remainder of the field was sown

with oats as a nurse crop, the mixture employed being 30 lb. permanent-pasture rye-grass, 10 lb. uncertified rye-grass, and 2 lb. permanent-pasture white clover.

The two hundred rye-grass plots in field 7 still afford great interest to visitors. Mr. Saxby, who inspected this field in June, reported that the relative densities of the types were as follows: Type 1, 100; type 3, 85; type 4, 44; type 5, 18; type 6, 16.

The main point of interest is the consistently lower density of type 3 plots over the past four years. This density appears to be improving slightly, due no doubt to the small percentage of good plants in type 3, which are now spreading. This is most noticeable in lines which have been border-line cases between types 1 and 3.

Club-root Investigations.

The club-root trials were confined to fields 1 and 2, which last season were in swedes. The soil was heavily infected with club-root, and it was found to be practically impossible to grow swedes as a second crop, although turnips were a possibility. The yield, however, was low in comparison with first-furrow land, and the percentage of club-root high.

Two lines of New-Zealand-grown Bruce turnip-seed were tried out against a commercial line with Aberdeen Purple Top as a control. This seed was sown by hand on land preridged and fertilized with 2 cwt. per acre of superphosphate through the front box plus 2 cwt. superphosphate and carbonate of lime mixed through the rear box.

Results were as follows:—

Variety.	Yield (Tons per Acre).	Percentage Club-root on Surviving Plants.
Bruce, Line A	13·8	31·2
Bruce, Line B	19·6	19·0
Bruce, Commercial	19·0	19·0
Aberdeen Purple Top	11·9	32·9

Bruce, Line B and Commercial respectively were significantly better in yield than the remainder.

The swede experiment containing selections and strains of Wilhelmsburger Otofte and Herning with the Majestic swede as a control was a complete failure due to club-root.

In another block in which nine lines were tested on behalf of merchants the swedes were again a failure, the best yielding 8·4 tons per acre. Two turnip varieties included in this block yielded as follows:—

	Yield (Tons per Acre).	Percentage of Club-root.
Wallace	16·6	19
Purple Top Yellow	17·7	23½

In this field acre blocks of the following turnips were also grown: Victor Achilles, Wallace, Irvine's Disease-resisting, with the following results:—

	Yield (Tons per Acre).	Percentage of Club-root.
Victor Achilles	26	26
Wallace	18	41
Irvine's Disease-resisting	16	55

A block of Edina swedes was also a failure due to club-root. Nitrate of soda at the rate of 1 cwt. per acre was applied as a top-dressing in February. This encouraged a little more leafage, but the swedes were too badly attacked to recover.

A further block was devoted to a ridged rape trial, one box of the ridger sowing Broad Leaf Essex and the other a special line of rape selected by the Mycologist for resistance to club-root. Counts on the roots were taken in January, and it was found that 61 per cent. of Broad Leaf Essex was infected, and 55 per cent. of the special rape. This was extremely disappointing when it is remembered that this line had for three years stood up remarkably well in the North Island to infection. It would appear that there are strains within club-root, and therefore that each district will need to work independently in the search for club-root resistance.

However, this rape, although infected, appeared to be able to develop new roots, and did not succumb to the attack as did the bulk of the Broad Leaf Essex. In fact, after feeding off, growth continued into the winter, so much so that the Field Mycologist made arrangements for some selected roots of this crop to be transplanted and seeded this season.

The Mai turnip was also tried out on this area, and it was found to be extremely resistant to club-root. The yield was approximately 15 tons per acre, which was doubled when sown in first-year ground with the same manuring. This soft turnip is of definite value to the dairy-farmer wishing to secure early autumn feed on land subject to club-root, but it is understood that the seed is practically unprocurable at the present time.

MISCELLANEOUS EXPERIMENTS.

In field 5, which was ploughed early in the winter, three varieties of swedes were grown—Tipperary, Success, and Webb's Masterpiece. One-half of the area was prelimed with 10 cwt. of carbonate of lime, and when ridged the manurial treatment consisted of 2 cwt. per acre of superphosphate applied through the front box plus 2 cwt. of a mixture of equal parts of superphosphate and carbonate of lime through the rear box.

Although no differences could be detected with the eye, on weighing the limed area the average yield was 40·7 tons per acre, compared to 34·3 tons on the unlimed. On the limed area the varieties yielded as follows :—

Variety.	Yield (Tons per Acre).
Success	44
Tipperary	43
Webb's Masterpiece	35

It would thus appear to be sound policy to lime immediately after breaking up ground, instead of the more usual practice in this district of liming when sowing down to grass.

A small oat-variety trial was hand-sown, and comprised the following varieties : Algerian (six selections), Ruakura, Garton's Abundance, and Lampton. Two blocks were autumn-sown, and one sown in the spring. The trial was handicapped, as some neighbouring lambs gained access and grazed the oats as late as November, and damage by birds precluded any observations as to grain-yield.

An experiment of great interest to grass-seed producers was laid down at the end of November. Three hundred lines of different rye-grass strains and twenty lines of timothy were included. These lines will be harvested separately this summer, with the idea of selecting lines

of high germination. The success of this experiment really depends on a heavy December rainfall, as it is this factor that is associated with the low germination of certified rye-grass seed grown in Southland in normal seasons.

A trial with Agrosan-treated oats was also carried out, but no differences could be detected compared with the block treated with formalin, both lines being free of smut.

A small hand-sown swede and turnip variety trial, including Elephant, Superlative, White Flesh Purple Top and Hernings swede, Imperial Green Globe, Green Top and Purple Top Aberdeen, Purple Top Mammoth, Devonshire Greystone, Lincoln Red Globe, and Mai turnip, was laid down in field 5, mainly in order to secure show material.

In field 13 the rate of liming trial on grass laid down in August, 1933, was kept under observation, and this year a lime difference due to increased cover was noticed on the block receiving the 4-ton application of carbonate.

ACKNOWLEDGMENTS.

The farm-manager, Mr. P. McMillan, deserves to be complimented on the volume of work performed in such a capable manner.

During the season under review the farm committee has been under the able chairmanship of Mr. D. H. McLean, Caroline.

Material assistance has again been forthcoming from the R. M. McKinnon Trust, in addition to the Government subsidy, which is greatly appreciated by the committee

The following firms donated swede and turnip seed: Messrs. F. Cooper, Ltd., Wellington; Messrs. Wright, Stephenson, and Co., Invercargill; and Messrs. J. and J. S. Price, Invercargill.

GOVERNMENT OFFICIAL HERD-TESTING OF PUREBRED DAIRY COWS.

SUMMARY OF THE 1934-35 SEASON'S WORK.

W. M. SINGLETON, Director of the Dairy Division, Wellington.

THE present summary, which is for the year ending 30th September, 1935, covers the eighth year of operation of the Government Official Herd-test. During this period 14,791 cows have been tested under this system, with an average of 1,849 cows per year since the commencement. It should be noted, however, that many of the cows included in this total have been under test for more than one lactation period. During the season under review 2,058 cows were tested, a falling-off of 127 cows from the 1933-34 total of 2,185. The present total is the third highest since its inception, the highest being 2,236 cows for the 1930-31 season. Again it is pleasing to record another increase in the number of herds, the figure for 1934-35 being 195, as against 184 for the preceding season, an increase of eleven herds. This is the highest number of herds yet tested during any one season under the Government Official Herd-test, and no doubt can be interpreted to signify an advancing popularity of the system with breeders using the Certificate-of-Record testing. The highest number of Certificate-of-Record breeders during the same period was 228, and therefore all but thirty-three breeders availed themselves of the opportunity to test other animals of their herd by means of the Government Official Herd-test. It is

probable that the unfavourable financial position compelled many breeders to choose the Government Official Herd-test in preference to the more expensive, although more complete, Certificate-of-Record Test, and this no doubt also contributed to the decrease in the number of Certificate-of-Record entries during the last few seasons. Signs of recovery, however, are apparent.

The average butterfat per cow has decreased by 1·86 lb., last season's average being 310·04, as compared with 311·90 lb. for the previous year, but a point worthy of note is that despite the unfavourable season the average milking period increased by five days, the figure for 1934–35 being 285 days, as against 280 for last season. The figures quoted, together with those in the accompanying tables, are on the basis of all cows on test for six months (180 days) or more, which has proved to be the most satisfactory classification, the Government Official Herd-test being a ten-months test. Cows other than registered purebreds are omitted from the tables, although a small number are tested each year by special arrangement. Last year the number of cows tested under this heading was thirty-one, as compared with thirty-two for the preceding season. The number of registered purebred cows which are not included in the summary tables total 151, these not being on test 180 days or more.

The following average butterfat figures for the different systems of testing in New Zealand may be of interest for comparison: New Zealand's average herd-test cow for the same season, including all cows in milk 100 days or more, yielded 252·01 lb. butterfat in 258 days. The Government Official Herd-test average on the same basis was 303·75 lb. in 280 days, while the Certificate-of-Record 305-day test average was 426·23 lb., and the Certificate-of-Record 365-day test, 527·45 lb.

Table 1.—Official Herd-testing in Two Past Seasons on Basis of all Cows on Test for 180 Days or more.

Breed.	Number of Breeders.	Number of Cows.	Average Yield for Season.		
			Days.	Milk.	Butterfat.
	Season 1933–34.			lb.	lb.
Jersey	152	1,393	282	5,998·0	324·72
Friesian	18	399	281	8,070·6	283·53
Milking Shorthorn	7	142	275	7,341·4	294·93
Ayrshire	2	25	253	6,430·3	265·14
Red Poll	2	25	251	5,227·9	209·19
Guernsey	1	5	275	6,113·9	310·25
Shorthorn	1	6	301	6,367·4	248·17
Totals and averages	179*	1,995	280	6,505·3	311·90
	Season 1934–35.				
Jersey	151	1,368	287	5,955·7	320·85
Friesian	20	285	284	8,271·6	295·10
Milking Shorthorn	7	182	276	6,332·9	264·69
Ayrshire	2	31	292	6,708·2	266·06
Red Poll	1	4	234	3,324·3	134·44
Guernsey	1	6	300	5,079·6	271·26
Shorthorn	Not represented.				
Totals and averages	178*	1,876	285	6,348·2	310·04

* Totals do not agree for the reason that some breeders tested more than one breed.

Table 2.—Average Production in Classes and Breeds for all O.H.T. Cows.

Class.		Season 1933–34. Number of Cows.	Average Days.	Average Milk.	Average Butterfat.	Season 1934–35. Number of Cows.	Average Days.	Average Milk.	Average Butterfat.
				lb.	lb.			lb.	lb.
Jersey	Two-year-old and under ..	561	283	5,383·4	292·85	582	286	5,252·4	282·42
	Three-year-old	258	286	6,196·0	339·64	218	287	6,139·9	341·51
	Four-year-old	210	279	6,358·0	344·65	199	286	6,465·8	346·45
	Mature	364	280	6,597·1	351·77	369	289	6,681·3	355·45
Friesian	Two-year-old and under ..	155	282	6,619·6	230·47	86	284	7,274·5	256·84
	Three-year-old	55	279	7,975·8	285·48	40	278	7,865·8	279·55
	Four-year-old	75	281	9,009·0	314·24	47	275	7,841·1	283·67
	Mature	114	282	9,471·6	334·54	106	289	9,447·5	338·24
Milking Shorthorn	Two-year-old and under ..	40	272	6,183·5	251·12	45	275	5,159·4	211·09
	Three-year-old	22	273	6,736·3	275·68	33	274	5,672·6	252·92
	Four-year-old	24	268	7,054·1	285·24	33	269	5,874·3	270·00
	Mature	56	281	8,529·3	337·92	71	281	7,597·2	301·63
Ayrshire	Two-year-old and under ..	16	253	6,008·7	252·31	6	291	5,099·7	209·79
	Three-year-old	6	240	6,595·7	263·50	2	287	5,844·2	245·40
	Four-year-old	1	222	6,310·2	279·15	4	303	7,338·4	292·02
	Mature	2	305	8,727·0	365·63	19	290	7,174·8	280·54
Red Poll	Two-year-old and under ..	14	239	4,535·2	180·54	4	234	3,324·3	134·44
	Three-year-old	5	274	5,830·8	235·60	..	..	..	..
	Four-year-old	4	253	5,626·7	220·09	..	..	..	..
	Mature	2	280	7,772·4	321·86	..	..	..	..
Guernsey	Two-year-old and under ..	..	..	..	..	2	305	4,739·8	252·77
	Three-year-old	1	216	4,141·9	216·00	..	..	..	..
	Four-year-old	2	305	6,366·2	327·21	..	..	..	..
	Mature	2	276	6,847·6	340·43	4	298	5,249·6	280·51
Shorthorn	Two-year-old and under ..	3	298	5,429·6	209·32	Not represented.			
	Three-year-old	1	305	6,010·2	264·95				
	Four-year-old	..	..	..	..				
	Mature	2	305	7,952·8	298·07				

THE USE OF INSECTICIDES IN THE CONTROL OF THE WHITE BUTTERFLY.

PROGRESS REPORT.

W. COTTIER, Entomology Section, Plant Research Station, Palmerston North.

ALTHOUGH it is anticipated that the imported parasites will keep down the numbers of the white butterfly to a sufficiently low level on cruciferous crops generally, it is considered probable that some additional chemical control may be necessary in such areas as market and private gardens, where often 100 per cent. control is necessary.

At the Plant Research Station last season an extensive series of very closely examined trials were carried out on white-butterfly control on cabbages, and it is the purpose of this article to discuss these results for the benefit of growers generally.

EXPERIMENTAL METHOD.

Cabbages were used for this work. Each row contained thirty plants spaced at a distance of 2 ft., and each row was 1 yd. apart. Each treated plot consisted of two adjoining rows containing altogether sixty cabbages. The row immediately on each side of each plot was left untreated to act as a control. The arrangement was thus: One untreated row; treated plot of two rows; one untreated row; treated plot of two rows; one untreated row, and so on, in this manner throughout the experiment. Thus each plot was provided with controls immediately adjacent, so that any variation in infestation over the blocks could be taken into consideration when determining results.

The sprays were applied with an ordinary knapsack spray-pump, and the dusts with the small hand duster shown in Fig. 2. The dusts, with a few exceptions, were applied at the same rate by volume, but the weights varied a great deal, the same volume of proprietary derris dusts varying from 11 lb. to 28 lb., according to the carrier used. The exceptions were some of the lead arsenate, calcium arsenate, and barium fluosilicate dusts, which in the particular tests concerned were applied at such rates that the same weight of arsenate or fluosilicate was applied per plot as was used in certain of the sprays.

The insecticides were applied in early January, early February, and the middle of February, and on one block a fourth treatment was given in the first days of March. The cabbages at times of treatment were large and well grown. Spraying was carried out during the day, but all dusting was made in the early morning when the dew was on the plants and the air was calm.

In late February and in March results of all treatments were secured by counting the numbers of white butterfly caterpillars on the cabbages in every row—treated and controls.

MATERIALS USED.

The insecticides used in the work were—Lead arsenate, calcium arsenate, barium fluosilicate, derris, pyrethrum, summer spraying oil, nicotine sulphate, nicotine dusts, common salt (sodium chloride).

The lead arsenate was used as a spray at the rates of 2 lb., 3lb., and 4 lb. per 100 gallons of water, there being added to each mixture ½ lb. of commercial spreading-agent or 6 lb. of soft-soap per 100 gallons. Sprays were applied at the rate of approximately 240 gallons per acre. Lead arsenate was also applied in the dry-dust form mixed with finely ground hydrated lime in the proportions of 1 part of lead arsenate to

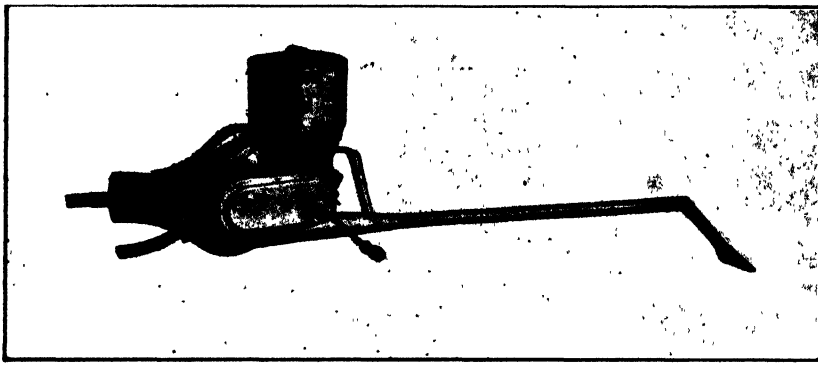

FIG. 1. HAND-OPERATED DUSTER SUITABLE FOR LARGE AREAS.

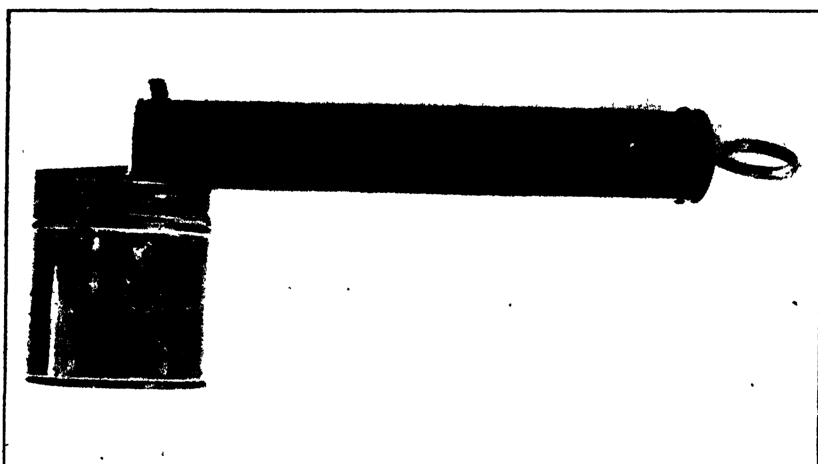

FIG 2. SMALL HAND DUSTER SUITABLE FOR GARDEN USE.

5 parts of lime and 1 part of arsenate to 10 parts of lime. Both concentrations were used at the rate of approximately 24 lb per acre.

Calcium arsenate, both as spray and dust, was used at the same concentrations and rates as was lead arsenate, hydrated lime again being used as a carrier for the dust.

Barium fluosilicate: The material used was a proprietary article stated to contain 80 per cent. of barium fluosilicate. Both as a spray

and dust this material was used at the same concentrations and rates as was lead arsenate, hydrated lime again being used as a carrier for the dust.

Derris dusts used were several proprietary articles containing from 0·5 per cent. to 0·75 per cent. rotenone, and, though the same volume of each dust was applied per acre, the weight per acre varied from approximately 11 lb. to approximately 28 lb. The derris sprays were also several proprietary articles, and were used according to the directions of the manufacturers, varying from 1 lb. to 20 gallons water to 1 lb. to 60 gallons water. Sprays were applied at the rate of approximately 240 gallons per acre. Derris preparations are made from plant extracts, and when used at the strengths recommended as insecticides are non-poisonous to humans.

Pyrethrum dusts were very difficult to secure, and only one proprietary dust was obtained. Pyrethrum sprays, however, were used at the rate of 1 part to 160 parts of water applied at approximately 240 to 300 gallons per acre. Alcoholic and kerosene extracts of fresh South African pyrethrum flowers were applied with an atomizer at the rate of 100 to 300 c.c. per sixty cabbages. The method of making the kerosene extract was as follows: 1 lb. of coarsely powdered pyrethrum flowers was added to 1 gallon of specially purified kerosene, kindly suppled by the Shell Co. of Wellington, New Zealand, as free as possible from aromatic, naphthenic, and unsaturated hydrocarbons. After standing twenty-four hours the mixture was filtered through cotton wool and was ready for use. A proprietary pyrethrum fly-spray was also used at the rate of 100 c.c. per sixty cabbages.

Like derris, the pyrethrum preparations are plant extracts which at concentrations sufficient to kill insects are harmless to man.

Summer spraying oil was used at concentrations of 1 part to 600 parts of water, 1 part to 100 parts of water, and 1 part to 60 parts of water. All spray mixtures were applied at the rate of approximately 240 gallons per acre. Summer spraying oil, 1 part to 100 parts of water plus a proprietary derris powder at the rate of 1 lb. to 20 gallons of spray mixture, was also used at the rate of approximately 180 to 240 gallons per acre.

Nicotine sulphate was used at concentrations of 1 part to 800, 400, and 250 parts of water at the rate of approximately 240 gallons of spray per acre.

Nicotine dusts were also used at the rate of 27 lb. per acre.

Common salt was used as a spray in water at concentrations of 3 per cent. and 4 per cent. by weight at the rate of approximately 240 gallons per acre.

For our work the calcium arsenate and derris preparations were supplied as follows: Calcium arsenate, obtained from the Fruit-growers' Federation, Wellington, N.Z. *Derris sprays*—"Katakilla," obtained from Messrs. Cooper, McDougall, and Robertson, Ltd., Box 599, Auckland, N.Z.; "Foliafume," a mixed derris and pyrethrum spray liquid obtained from Messrs. J. A. Messenger, Ltd., 1 Anzac Avenue, Auckland, N.Z.; "Dactine," from Messrs. W. J. Craven and Co., Ltd., 48 and 50 Port Street, Evesham, England; "Dekko," from Messrs. W. J. Craven and Co., Ltd.; "Granulated Derris Extract,"

from Messrs. Stafford, Allen, and Sons, Ltd., Cowper Street, Finsbury, London, E.C. 2; "Derris Powder, with Spreader," from the Committee of Direction of Fruit Marketing, Box 771 L, G.P.O., Turbot Street, Brisbane, Queensland, Australia. *Derris Dusts*—"Deridust," from Messrs. J. A. Messenger and Co., Ltd., 1 Anzac Avenue, Auckland, N.Z.; "Derris Root Dust," from Committee of Direction of Fruit Marketing, Box 771 L, G.P.O., Turbot Street, Brisbane, Queensland, Australia; "Wee-Bee 40," from Messrs. W. J. Craven and Co., Ltd., 48 and 50 Port Street, Evesham, England; "Derris Powder," from Messrs. Stafford, Allen, and Sons, Ltd., Cowper Street, Finsbury, London, E.C. 2; "Derridust," from Messrs. W. J. Gandy, Ltd., 19 Tory Street, Wellington, C. 3, N.Z.

It is to be understood that the list of proprietary preparations shown above is merely a record of such materials used, and there is absolutely no intention of recommending them above any other such mixtures that may be on the market.

RESULTS.

The results show that excellent control was secured with all concentrations of lead-arsenate and calcium-arsenate sprays. The lead and calcium arsenate dusts with lime were inferior to the sprays, even when the same amount of arsenate was applied in both dust and spray. The derris dusts and sprays gave excellent control, for all practical purposes being as good as the arsenate sprays, and certainly better than the arsenate plus lime dusts. The barium-fluosilicate sprays gave inferior results and burned the cabbage foliage, while the barium-fluosilicate dusts gave poor results. Nicotine-sulphate spray, even at a concentration of 1 part in 250 parts of water, gave extremely poor results, as also did the dusts. The pyrethrum dusts also were of no use. A pyrethrum spray at a concentration of 1 part to 160 parts of water gave fairly good results. The proprietary house-fly spray of pyrethrum extract also gave fairly good results, while the kerosene extract of fresh South African pyrethrum flowers gave very good results. The derris plus summer-oil spray gave excellent control, whereas the oil sprays alone gave very poor control. The salt solutions gave very poor results, and the 4-per-cent. strength stunted the growth of the cabbage foliage.

THE USE OF LEAD ARSENATE AND OTHER ARSENICAL SPRAYS.

In 1903 the Royal Commission on Arsenical Poisoning in London, decided that food for human consumption must not contain more than 0·01 grain of arsenic calculated as arsenic trioxide per pound of food material. In 1926 the subject received special interest on account of the fact that apples imported from America into England were found to be above this arsenic tolerance. Because of the amount of arsenate that must be used to combat the codling moth in America, it has since been found necessary, before marketing, to wash the arsenical residues from the fruit so that the amount can be brought to within the regulation limit. In the United States the same limit applies to fresh vegetables, which, prior to the last few seasons, were extensively sprayed with lead and calcium arsenate to control chewing insects, among these being the white butterfly. During 1932 and 1933, however, so many interstate consignments of cabbages and cauliflowers were seized and confiscated by the authorities because of excessive arsenical residues that the market was threatened with demoralization. Since that

time strenuous efforts have been made to find something to replace the arsenical sprays. The result has been the large production of derris insecticides. To-day, in the United States, derris preparations are rapidly replacing arsenicals for use on market-garden crucifers and promise to accomplish this completely in a few more seasons.

In New Zealand the regulations under the Sale of Food and Drugs Act, 1908, do not allow the presence of any arsenic or lead at all on fresh cabbages and cauliflowers. Therefore, technically, any person who uses lead arsenate on cabbages or cauliflowers and offers them for sale is likely to render himself liable to a penalty under the Act, if it is suspected that his produce contains spray residues. Perhaps it may be assumed, however, that trouble would arise only if the vegetables should contain more than 0·01 grain of arsenic trioxide per pound, the limit fixed by the Royal Commission for such foodstuffs.

To determine how much arsenic is likely to remain on cabbages sprayed with lead arsenate in adequate amounts to give control, analyses of such cabbages were carried out by the Dominion Analyst last season. The cabbages to be analysed were treated in two ways. The first lot was stripped of outside leaves so that only the heart remained, whereas the second lot comprised whole cabbages with the outside leaves not removed. The results are shown in Table 1. Sprayings were carried out at three periods—viz., 10/1/35, 1/2/35, and 11/2/35.

Table 1.

No.	Treatment.	Condition.	Number of Grams of As_2O_3 per Pound of Cabbage.	Length of Time between Last Spraying and Harvesting.
Lot 1.—No. 1	Lead arsenate 2–100 plus spreader ½–100	Heart only ..	0·0005	5 weeks
No. 2			0·0003	
No. 3			0·0002	
No. 4			0·0003	
Lot 2.—No. 1	Lead arsenate 3–100 plus spreader ½–100	Heart only ..	0·0001	,,
No. 2			0·0001	
No. 3			0·0001	
No. 4			0·0001	
Lot 3.—No. 1	Lead arsenate 4–100 plus spreader ½–100	Heart only ..	0·0002	,,
No. 2			0·0002	
No. 3			0·0002	
No. 4			0·0003	
Lot 4.—No. 1	Lead arsenate 2–100 plus spreader ½–100	Whole cabbage	0·026	6 weeks 3 days.
No. 2			0·024	
No. 3			0·013	
No. 4			0·036	
Lot 5.—No. 1	Lead arsenate 3–100 plus spreader ½–100	Whole cabbage	0·045	Ditto.
No. 2			0·050	
No. 3			0·068	
No. 4			0·058	
Lot 6.—No. 1	Lead arsenate 4–100 plus spreader ½–100	Whole cabbage	0·118	,,
No. 2			0·231	
No. 3			0·188	
No. 4			0·220	

From the table it will be seen that hearts only were well below the arsenic tolerance of 0·01 grain per pound if an interval of five weeks elapsed between the last spraying and the time of harvesting. However, figures for the whole cabbages, without outside leaves removed, show that the arsenic tolerance of 0·01 grain per pound was quite easily exceeded even after a period of six weeks had elapsed between the last spraying and the time of harvesting.

The lead residue also should be considered, since it is well known that this metal has a cumulative action and is not voided from the system as is arsenic. Very small doses accumulate until they have a pathological effect, even after a period of years.

DISCUSSION.

From the foregoing it is very evident that there is great need for a non-poisonous spray to replace the arsenicals for application to vegetables. It does not seem that there can be any satisfactory guarantee to the public that only the hearts of such vegetables, especially cabbages, will be offered for sale, and, further, that a sufficient time will elapse between the last treatment and the time of harvesting. It would not be in the best interests of the market-garden industry to run the risk of having vegetables looked on with suspicion by the health authorities and the public.

If the arsenates are ruled out as unsuitable insecticides for crops to be marketed, the situation might seem more or less desperate However, this is not the case, because it has been demonstrated in our work that derris dusts and sprays are highly efficient in giving protection against the white butterfly The control given was adequate and comparable with that given by lead-arsenate sprays, and this is also the conclusion that has been reached in work against this pest in other parts of the world. Besides being comparable with lead arsenate in killing-power, derris preparations have the great advantage that they can be used right up to the time of harvesting without any fear of poisoning to warm-blooded creatures, including man and the domestic animals. Derris preparations are usually somewhat more expensive than lead arsenate, but it is considered that prices are well within the limit of cost allowable in producing vegetables, and it is hoped that such non-poisonous insecticides will eventually be used to the exclusion of arsenicals

Work in other countries shows that derris dusts are more effective generally than are sprays, and in our one season's experience in New Zealand the dusts were slightly superior to the sprays. Several treatments may be required at intervals of two or three weeks according to the severity of infestation. Growers wishing to use derris should make sure that the dust has a guaranteed rotenone content of 0·5 per cent to 0·75 per cent. and it should be applied at the rate of 20 lb. to 25 lb. per acre, according to the manufacturers' instructions. (Rotenone is one of the active principles of derris insecticides, and the potency of the insecticide is commonly expressed on the basis of the proportion of rotenone it contains.) Fig. 1 shows a hand-operated dust-gun suitable for fairly large areas. If, however, the grower has spraying-apparatus only and prefers not to change, then he will be able to secure spray powders suitable for his purpose.

This experimental work will be continued next season and results published when available.

AGRICULTURAL LEGISLATION OF 1935.

A. E. MORRISON, Solicitor, Department of Agriculture, Wellington.

THE following notes are made on the provisions of several Acts of agricultural interest which were passed during the 1935 session of Parliament.

AGRICULTURAL REGULATIONS CONFIRMATION ACT, 1935.

By this Act the following regulations made under the Agriculture (Emergency Powers) Act, 1934, were confirmed and validated—viz., the Dairy Factories (Licensing) Regulations, 1935, and regulations authorizing dairy companies to borrow moneys out of funds provided under section 26 of the Agriculture (Emergency Powers) Act, and to lend such moneys to their suppliers of milk or cream.

PRODUCTS EXPORT AMENDMENT ACT, 1935.

This statute extends the definition of the term "products" for the purposes of the Products Export Act, 1908, to include timber, in order that the export of certain species of beech timber may be regulated and controlled in accordance with regulations to be made under the principal Act.

RABBIT NUISANCE AMENDMENT ACT, 1935.

This Act authorizes Rabbit Boards to deal in poisons or ammunition for the purpose of the destruction of rabbits in their districts or for the prevention of the incursion of rabbits therein, and for that purpose licenses may be granted under the Poisons Act, 1934, to sell poison, or under the Arms Act, 1920, to sell ammunition. The power of Rabbit Boards to sell poison in pursuance of a license granted under the Poisons Act is limited to poisons for the time being included in the Third Schedule to that Act. All purchases, sales, or other dispositions of poison or ammunition made by Rabbit Boards for the destruction of rabbits before the 11th day of October, 1935, are validated.

TOBACCO-GROWING INDUSTRY ACT, 1935.

By this Act a Board called the Tobacco Board is established. The Board shall consist of nine persons to be appointed by the Governor-General on the recommendation of the Minister of Industries and Commerce, one member being appointed as the Government representative, four members as growers' representatives, and a like number as manufacturers' representatives. The Government representative shall be the Chairman of the Board.

No tobacco shall be grown in New Zealand except in pursuance of a license granted by the Board and in accordance with such conditions to be attached to the license as are prescribed. Conditions so prescribed and attached to a license may relate to the quantity of tobacco that may be grown, the land on which it is to be grown, and the area to be used for growing the tobacco under the license. No license is required in respect of the growing of any tobacco by any person on his own land so long as no tobacco so grown is manufactured or intended to be manufactured except by the grower for his own use and that of

the members of his family residing with him, and not for sale to any other person, and so long as the tobacco so grown is not sold or intended to be sold to any other person. Every license granted for the growing of tobacco shall remain in force until the 31st July following the date stated in the license as the day on which it takes effect. The Board has a discretionary power to refuse to grant licenses for the growing of tobacco on such grounds as it shall deem sufficient. Where, however, a grower satisfies the Board that he has entered into a *bona fide* contract or arrangement with any person for the growing before the 31st July in any year of tobacco for sale to that person, the grower shall be entitled to the grant of a license for the growing of that tobacco before the date mentioned, and of a warrant authorizing him to sell the tobacco.

No raw tobacco grown or intended to be grown in New Zealand shall be sold or purchased by or on behalf of any person, and no raw tobacco grown in New Zealand shall be manufactured by or on behalf of any person who has not purchased it, except in accordance with a warrant granted by the Board authorizing such sale, purchase, or manufacture, and subject to such conditions to be attached to the warrant as may be prescribed. No warrant is required in respect of the manufacture by any person of any tobacco grown by him or on his own land for the use of himself and the members of his family residing with him and not for sale to any other person. Every warrant granted under the Act shall, unless previously revoked, continue in force for such period as may be prescribed. The discretionary powers of the Board to refuse to grant licenses for the growing of tobacco apply, *mutatis mutandis*, to the grant of warrants under the Act. Where, however, a *bona fide* manufacturer satisfies the Board that he has entered into a *bona fide* contract or arrangement with a grower for the growing of tobacco for sale to the manufacturer, the latter shall be entitled to the grant of a warrant authorizing him to purchase that tobacco. Any person shall also be entitled to the grant of a warrant authorizing him to purchase any tobacco if the Board is satisfied that the tobacco is to be exported.

The Board may require information to be supplied to it by manufacturers, growers, and other persons in relation to the tobacco industry in New Zealand. The manufacturer may be required to supply information in respect of the quantity of raw tobacco grown in New Zealand and used by him for the purposes of his business in any period, or owned or held by or on his behalf for the purposes of his business at any time ; an estimate of the quantity of such tobacco that he will use for the purpose of his business in any period, with particulars of the sources from which he proposes to obtain that tobacco ; and the names and addresses of all persons who have contracted to supply him with raw tobacco grown or to be grown in New Zealand, with particulars of each contract and the quantity of tobacco to be supplied by each person. The grower may be required to supply information in respect of the quantity of tobacco grown or to be grown in any period ; of raw tobacco grown or to be grown and sold in any period or held by the grower and unsold at any time ; the price at which any raw tobacco grown or to be grown has been sold ; the area of land on which tobacco has been or is to be grown in any period or is being grown at any time ; and the names and addresses of all persons to whom the grower has contracted to supply raw tobacco, with particulars of each

contract and the quantity of tobacco to be supplied to each person. The Board may also, with the approval of the Minister of Industries and Commerce, require any person (whether a grower or manufacturer or not) to supply such further information as may be deemed necessary for the effective administration of the Act, but not including information relating to formulæ, methods, or processes used in manufacture, costs of manufacture, or any other matter incidental to the process of manufacturing tobacco. All information furnished by manufacturers and growers shall be treated as confidential, and shall be supplied to the Chairman of the Board—*i.e.*, the Government representative. Except as otherwise directed by the Minister of Industries and Commerce, all information supplied by other persons shall be similarly treated as confidential. The Chairman may, however, lay before members of the Board returns showing the aggregate results of the information so supplied, classified in such manner as he thinks fit.

The Board may endeavour to promote the sale or disposal in New Zealand or elsewhere of raw tobacco grown or to be grown in New Zealand, and may recommend to the Government such action as the Board deems advisable in relation to the importation of raw or manufactured tobacco. For the purposes of the Act, raw tobacco means unmanufactured tobacco or the leaves and stems of the tobacco-plant before they have passed through any process of manufacture.

There shall be payable to the Board by way of levy on raw tobacco grown or to be grown in New Zealand and sold by or on behalf of the grower or manufactured by or on behalf of any manufacturer who has not purchased it, such charges—not exceeding a levy of ½d. per pound—as may from time to time be fixed by the Board. The Board may fix differential charges in respect of different classes of tobacco, and for that purpose may divide tobacco into such classes as it thinks fit. Charges may be fixed in respect of specified classes of tobacco without fixing any charges in respect of other tobacco. Fees at rates to be prescribed shall also be payable in respect of applications for licenses and warrants, and in respect of licenses and warrants granted under the Act.

Every person who obstructs or impedes or attempts to obstruct or impede the Board or its servants or agents in the exercise of any power, function, or duty conferred on the Board, or who fails to comply with any condition attached to a license or warrant granted under the Act or with any requirement of the Board or any provision of the Act or any regulations made thereunder, shall be liable on conviction to a fine of £100, and, in the case of a continuing offence, to a further fine of £10 for every day during which the offence continues. On conviction, the Court may revoke any license or warrant granted to the offender and then in force.

The Executive Commission of Agriculture has the same powers with respect to the Tobacco Board as it possesses with respect to other Boards established to regulate and control primary products.

Nothing in the Act shall be construed to restrict the operation of the Tobacco Act, 1908.

GENERAL.

In addition to the foregoing, reference is made to the provisions of a local Act entitled the Auckland Metropolitan Milk Amendment Act, 1935, and to certain provisions of the Finance Acts, 1935. The Auckland Metropolitan Milk Amendment Act removes certain defects found to exist in the principal Act, and generally provides better or additional

powers to regulate and control the supply and distribution of milk within the Auckland Metropolitan Milk District, which has been extended to include the Auckland Domain and Hospital Reserve, the ports of Auckland and Manukau, and any ship or vessel while in either of these ports.

Section 20 of the Finance Act, 1935, provides for the payment to local authorities from the Main Highways Revenue Fund of a subsidy equal to 12½ per cent. of the rates levied for the year ending 31st March, 1936, on lands used exclusively or principally for agricultural, horticultural, or pastoral purposes, such subsidy to be applied in relief of ratepayers by way of refund or rebate of a like percentage of the rates levied on such lands for the current financial year.

By section 37 of the Finance Act (No. 2), 1935, the New Zealand Meat-producers' Board, the New Zealand Dairy Board, the New Zealand Fruit-export Control Board, the New Zealand Honey Control Board, the New Zealand Poultry Board, and the Tobacco Board may out of their funds subsidize any fund or scheme established with the approval of the Governor-General in Council for the purpose of providing superannuation or retiring-allowances for their staffs.

THE DAIRY FACTORY MANAGERS REGULATIONS, 1934, AMENDMENT NO. 2.

THE main purpose of the above-entitled regulations, which came into force on the 5th December, is to prescribe in detail the qualifications of persons competent to be employed as managers of butter and/or cheese factories for the purpose of determining their eligibility for registration under the regulations governing the registration of dairy factory managers.

An applicant for registration after the coming into force of the amending regulations must—(a) Have passed the sixth standard in the primary schools or have attained a standard of education equivalent thereto, (b) have held a cream-grader's or a milk-grader's certificate, (c) be of good character and reputation, (d) satisfy the Dairy Factory Managers Registration Board that he has had practical experience in the performance of the major operations in a butter or a cheese factory, (e) satisfy the Registration Board that he has a reasonable general knowledge of the construction and functions of the plant, apparatus, and machinery used in the production and manufacture of dairy-produce, of dairy-factory management generally, and of the law regulating such production and manufacture With regard to practical experience, an applicant must satisfy the Board that he has been actively engaged in the performance of manufacturing creamery butter and/or cheese in all its branches and that he has had in the course of his training and practical work immediate charge of and responsiblity for each of the major operations in a butter or a cheese factory, as the case may be, for a period of not less than three months. The major operations in a butter-factory are—(i) Control of the receiving platform, (ii) the neutralization, pasteurization, and cooling of cream; (iii) churning, with complete control over the whole or some number of churns in a butter-factory The major operations in a cheese-factory are—(i) Control of the receiving-platform or one weighing-scale thereon; (ii) the pasteurization and cooling of milk, and (iii) the manufacture of cheese, with complete control over the whole or some number of vats from the time of setting until the cheese is placed in hoops

The matters referred to in general terms in paragraph (e) above as to which the Registration Board is required to be satisfied before authorizing registration are set out in detail in new clauses 10A and 10B contained in clause 5 of the amending regulations. In addition to the foregoing, other amendments to the principal regulations designed to facilitate administration are included in the amending regulations under notice. Persons interested may obtain copies of the regulations on application to the Government Printer, Wellington, price 6d. per copy, remittance with order.

—*A. E. Morrison, Solicitor, Department of Agriculture, Wellington.*

APPLICATION OF ORCHARD-SPRAYS.

1. THE STATIONARY SPRAYING SYSTEM—(*continued*).

G. G. TAYLOR, Mycological Laboratory, Plant Research Station, Palmerston North.

B. The Pumping Station.

THE pumping-shed houses the equipment necessary for driving the spray mixture, under pressure, through the orchard pipes to the nozzles. Associated with the pumping-station are reservoirs and elevated holding-tanks for maintaining the water-supply.

THE PUMP.

During recent years manufacturers have made considerable improvement in the mechanical efficiency of the force pumps used for orchard-spraying, and to-day there is little to choose between the standard makes. Apart from mechanical efficiency, the significant factors to be considered when installing a pump are capacity—*i.e.*, volume delivery in gallons per minute—working pressure, and pressure-adjustment.

CAPACITY.

In determining the pump-capacity required the maximum volume of spray delivered by the nozzles should first be calculated by allowing for a delivery of 3 gallons per minute for each nozzle (or combination of nozzles) in use. Owing to mechanical losses in capacity at the pump due to " slip,"* worn valves, &c., and because a certain amount of overflow through the release-valve is necessary to maintain even pressure, the specified capacity† of the pump should exceed that calculated for supplying the nozzles by approximately 30 per cent.

In the manufacturers' specifications of a pump, capacity is usually quoted at a maximum working speed. Experience has shown, however, that greater efficiency is obtained by lowering this speed of working by 30 to 50 per cent. Since this causes a corresponding reduction in the volume of liquid pumped, the specified capacity of the pump should be sufficiently high to allow for reduced working speed and still leave the capacity approximately 30 per cent. greater than is required to supply the nozzles.

For example, with three men spraying, the maximum volume delivery at the nozzles will be approximately 9 gallons per minute. Allowing 30-per-cent. increase, the capacity required at the pump will be approximately 12 gallons per minute. By installing a pump with a specified capacity of 20 gallons at 100 revolutions per minute and reducing the working speed to 60 revolutions per minute, the required capacity of 12 gallons could be obtained.

* The term " slip " is applied to losses in capacity caused by valve lag, and separation of liquid and piston on the suction stroke.

† In considering pumps of American manufacture the specified capacity should be converted from American to Imperial units on the basis of 5 American gallons = 4 Imperial gallons (approximately).

PRESSURE.

The pressure developed by the pump should be sufficient to overcome frictional resistance to the flow of spray in the pipes and to provide for efficient mist production at the nozzles. In a properly designed piping-system maximum pressure-loss should not exceed 150 lb. per square inch, and with the nozzles at present used in New Zealand approximately 300 lb. pressure per square inch is required for efficient mist-production. Thus the pump should be capable of developing a maximum pressure of 450 lb per square inch.

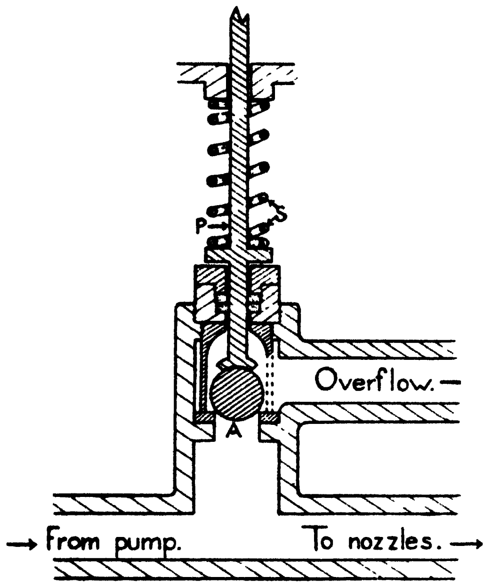

FIG. 10. RELEASE-VALVE.

Showing the ball valve A which opens when the pressure overcomes the force exerted on the stem P by the spring S.

PRESSURE-ADJUSTMENT.

For adjusting pump - pressure and allowing excess spray to be returned to the mixing-tank, either release-valves or pressure-regulators are used. In the former (Fig. 10) a spring-loaded stem acts directly on a ball valve, which lifts when the pressure is sufficient to overcome the force exerted by the spring, thus releasing pressure. In the latter (Fig. 11) a spring-loaded plunger or diaphragm lifts when the pressure is sufficient to overcome the force exerted by the spring, pressure being released through a ball valve which is unseated by means of a projecting pin attached to the plunger or diaphragm. Where release-valves are used, the pump, when in operation, is continuously working against pressure. With pressure-regulators, an additional ball valve holds the pressure in the pipe-line and beneath the plunger or diaphragm when the nozzles are closed, thus releasing pressure on the pump. Release-valves being of simple construction give little trouble in operation, and are easy to adjust. Pressure-regulators are more complicated, and thus

require greater care in adjustment to give efficient results. When properly adjusted, however, they reduce wear in the pump and lower running-costs, and for these reasons are the type usually installed.

To reduce pressure-fluctuations caused by intermittent pumping action an air-chamber is used, this being placed adjacent to the pressure-regulator and connected to the main delivery pipe. The contained air is compressed by each force stroke and expands with each suction stroke, thus helping to maintain even pressure. The volume of air in the chamber is reduced to approximately one-thirtieth of its original volume when under a pressure of 450 lb. per square inch, so that to function efficiently air-chambers should be of large size. Efficiency is further increased where provision is made for filling the air-chamber (by means of the pump) with compressed air before spraying is commenced.

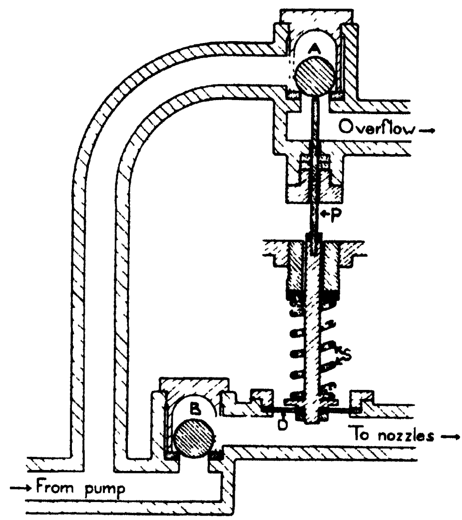

FIG. 11. PRESSURE-REGULATOR.

Showing the diaphragm D which lifts when the pressure overcomes the force exerted by the spring S and by means of the projecting pin P unseats the ball valve A. The ball valve B holds the pressure in the pipe-line and beneath the diaphragm when the nozzles are closed, thus leaving the ball valve A unseated.

A pressure-gauge is required in order to make accurate adjustment of pressure. Because of their delicate mechanism, and owing to the strain imposed by intermittent pumping action, gauges are easily rendered inaccurate. It is advisable to place the gauge either on top of the air-chamber or on a special air-chamber consisting of a length of ¾ in. pipe, since in this position it is least subject to strain.

MIXING-TANKS.

Concrete or wooden mixing-tanks are used for holding the spray mixture. Either give efficient service, but concrete tanks have the advantage that they do not deteriorate. In small orchards a single mixing-tank is sufficient ; in larger orchards the time lost by nozzlemen in waiting for spray mixtures to be prepared can be avoided by the use of duplicate tanks.

The size of the tanks should be such that they may be emptied in about one hour, since sprays such as nicotine deteriorate if left for longer periods, and combinations such as lead arsenate and lime sulphur become liable to cause tree injury. The approximate size may be calculated by allowing 150 gallons tank capacity—(*i.e.*, 24 cubic feet) for each nozzleman.

Mixing-tanks are invariably built square or oblong in plan, the use of cylindrical tanks having been abandoned owing to difficulties in agitation, cleaning, &c. In designing tanks the bottom should be rounded to assist agitation, sufficient slope allowed towards the suction intake from the pump for complete emptying, and a large plug-hole provided at the lowest point to facilitate cleaning. Tanks deeper than 3 ft. 6 in. are inefficient, owing to their inaccessibility and because increase in depth reduces the efficiency of agitation. In determining the dimensions required to give any particular capacity, allowance should be made for the curvature in the bottom and for a height about 6 in. in excess of the level of the spray mixture. When building concrete tanks the surface should be finished with cement plaster to prevent leakage

The spray mixture is delivered to the pump either through a pipe built permanently into the bottom of the tank or through a flexible pipe which hangs from the lip of the tank The latter type is preferable, being more easily cleaned and readily moved from one tank to another.

AGITATORS.

Agitation of the spray mixture is necessary to maintain even distribution of particulate solids and to assist in the production and maintenance of oil emulsions. The type of agitator most commonly employed consists of a horizontal shaft provided with two-bladed propellors and driven by the pump engine. Agitators with vertical shaft are rarely used, since they do not give as efficient agitation as horizontal types, being suited only to cylindrical tanks. The number of propellors required depends on the size of the mixing-tanks, two being used with a 200 gallon tank, three with a 300 gallon tank, &c. In order to maintain effective agitation until the tank is emptied, the shaft should be situated so that the propellor-blades nearly touch the bottom of the tank. This type of agitator driven at about 100 revolutions per minute gives satisfactory results with the spray mixtures at present used in New Zealand.

THE POWER UNIT.

Petrol-engines or electric motors are used for driving the pump and agitator. Where electric power is available the motors are preferable, since they are not subject to the erratic engine-speeds of the former, are easier to operate, less expensive to purchase, and, being relatively free of mechanical troubles, are cheaper to keep in repair.

Horse-power requirements depend mainly on pump-capacity and working-pressure, but additional power is required to overcome frictional resistance in the pump and to drive the agitator. The required brake horse-power may be determined by allowing 1 b.h.p. for each 10 gallons pump-capacity at 100 lb. pressure per square inch. Thus a pump of 10 gallons capacity working at 450 lb. pressure requires a power-unit of approximately 4·5 b.h.p., and a pump of 15 gallons capacity working at 450 lb. pressure requires a power unit of approximately 6·75 b.h.p., &c.

Reliance, usually, can be placed on the specified brake horse power of electric motors, but not on the rated values of many petrol-engines. Where petrol-engines are to be used it is advisable, therefore, to install those of reputable manufacture and guaranteed performance.

Reservoirs and Holding-tanks.

Reservoirs are necessary in some districts to conserve a supply of water for periods of drought, and in most orchards elevated holding-tanks are required to provide a rapid flow of water for filling the mixing-tanks.

Concrete reservoirs built into the ground have been found most efficient for holding large quantities of water. The size required depends on the volume of water used to spray the orchard and on the maximum period over which shortage is likely to occur. Reservoirs should be as deep as possible, with a small surface area which can be boarded over, thus reducing loss of water by evaporation, which from an uncovered surface 20 ft. square may exceed 200 gallons per week. Where possible, the reservoir should be at a higher level than the pumping-station and provided with a large-diameter delivery-pipe, thus obviating the use of an additional holding-tank.

Holding-tanks may be built in concrete or made of galvanized iron. They should be situated adjacent to the pumping-station and at a higher level than the mixing-tanks, and provided with a large-diameter delivery-pipe. For filling the holding-tank a small auxiliary pump is required, with sufficient capacity to maintain the water-supply for one complete spraying-period. The size of the holding-tank should be such that the volume of water it will hold, plus the amount that can be pumped into it during the day, will be sufficient for one day's spraying.

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STREPTOCOCCI WHICH PRODUCE A SUBSTANCE INHIBITING THE GROWTH OF LACTIC STREPTOCOCCI.

OCCURRENCE AND DISTRIBUTION.

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Whitehead and Riddet(1) succeeded in isolating from certain milk-supplies an organism which was shown to be the cause of an inhibition of acid-production during the cheesemaking process. The phenomenon is colloquially known among cheesemakers as " non-acid " trouble. Since the first observation many instances of slow development of acidity in single vats of milk have been proved to be due to the presence of the same type of organism. Whitehead(2) gave an account of the biological properties of two strains of the inhibitory organisms and showed that they were lactic streptococci; one strain resembled *Str. cremoris* and the other *Str. mastiditis*, except that in both cases a peculiar inhibitory substance was formed during growth.

It was considered desirable to make some attempt to determine the habitat of inhibitory streptococci in the hope that if there were any predominating source it would prove possible to give more precise directions for the exclusion of the organisms from milk on the farm. The similarity of some strains to *Str. mastiditis* suggested that they might be found within the udder in some cases of disease. On the other hand, Mr. W. H. Udy, of the N.Z. Co-op. Dairy Co. (private communication) was able to isolate strains very readily from silage. The present paper is an account of a more detailed examination of the possible sources.

METHODS USED FOR DETECTION OF INHIBITORY STREPTOCOCCI.

During the course of our investigations Cox(3) devised a simple method, depending on the use of methylene blue, for the detection of inhibitory streptococci or their products in milk-samples. This replaced the more tedious method of the "vitality test," and enabled large numbers of samples to be examined at the one time. Moreover, the detection of small numbers of inhibitory streptococci in samples of milk freshly drawn necessitated the employment of an enrichment method, since any method of rapid detection, apart from actual isolation of the organisms, depends on the production of a reasonable amount of inhibitory substance in the milk. Milk samples were therefore incubated at 30° C. until clotting took place. Three millilitres of the clotted sample were mixed with 15 millilitres of normal fresh milk and after the mixture had been pasteurized at 63° C. for fifteen minutes it was tested according to Cox's methylene-blue technique. The method has obvious limitations: if the number of inhibitory streptococci is below some undefined minimum, the organisms may fail to grow on occasions. Moreover, in some cases the streptococci may be overgrown and checked by other organisms, and thus prevented from forming a detectable amount of the inhibitory substance. The inhibitory streptococci are favoured in milk, however, since they belong to the group of lactic-acid organisms, and with a reasonable initial number in any sample one would not expect a large percentage of failures in detection. The relative sensitivities of the "vitality test" and the methylene-blue test for inhibitory organisms were compared in the following experiment. A culture of inhibitory organisms was mixed with fresh milk in various proportions, and portions of each mixture were pasteurized at 63° C., 82° C., and 100° C. for thirty minutes. Methylene-blue tests for the presence of inhibitory substance were then carried out, as well as a vitality test on a portion of each mixture heated to 63° C.

The results (Table 1) show that although the vitality test demonstrates quite satisfactorily the presence of inhibitory organisms, the methylene-blue method gives in general a more clear-cut and outstanding result in borderline cases.

From columns IV, V, and VI it is evident that the methylene-blue inhibitory test was most sensitive when the heating was carried out at 63° C. Heating at higher temperatures evidently destroyed a certain amount of the substance produced by the inhibitory organisms. For this reason 63° C. was chosen as the best temperature for heating the tubes of milk. Another experiment showed that heating at this

Table 1

No. of Sample.	The Milks and their Quality: I. Proportions in which Milk and Culture mixed. Parts Fresh Milk.	Parts Thick Culture.	II. Number of Organisms per Millilitre: Breed's Method.	III. Reductase Test on Raw Milk. Time for Discolorization.	Tests for Inhibitory Organisms. Methylene-blue Test. IV. Tubes of Milk pasteurized at 63° C., ½ Hour.	V. Tubes of Milk pasteurized at 82° C., ½ Hour.	VI. Tubes of Milk heated at Boiling Temperature. ½ Hour.	Vitality Tests. VII. Milks pasteurized in Bottles at 63° C., ½ Hour: 1 per Cent. Starter added to each. 5½ Hour.	6½ Hour.	Rise.
1	15 +	3	456,000,000	5 minutes	4¼ hours	4¼ hours	4¼ hours	1·9	2·0	0·1
2	15 +	2	324,000,000	10 minutes	4¼ hours	4¼ hours	4¼ hours	1·7	1·8	0·1
3	15 +	1	246,000,000	¼ hour	4¼ hours	4¼ hours	4¼ hours	1·5	1·8	0·3
4	15 +	0·5	91,800,000	¾ hour	4¼ hours	4¼ hours	¾ hour	1·5	2·1	0·6
5	15 +	0·1	15,600,000	3½ hours	4¼ hours	2¼ hours	¾ hour	2·5	4·8	2·3
6	15 +	0·05	7,320,000	3¾ hours	4¼ hours	1¼ hours	¾ hour	2·5	5·3	2·8
7	15 +	0·01	1,140,000	5½ hours	2¼ hours	1¼ hours	¾ hour	3·8	6·2	2·4
8	Control	..	980,000	> 5½ hours	2¼ hours	1½ hours	¾ hour	3·4	6·5	3·1

temperature for ten to fifteen minutes was as satisfactory as heating for half an hour, and the shorter time was therefore adopted in general practice.

OCCURRENCE OF INHIBITORY ORGANISMS IN MIXED MILK.

It was of interest in the first place to determine how often the organisms occurred in a mixed supply of good-quality milk produced with a reasonable amount of care but with no special precautions. The milk-supply under examination (that of the Massey Agricultural College Farm) was used for the manufacture of cheese from September to May, and on no occasion during that period was any trouble due to inhibitory organisms experienced in the cheese-vat. Samples of the milk were taken daily; they were incubated at 30° C. until they clotted (two to three days), and were then tested for the presence of inhibitory substance by the methylene-blue method. Table 2 shows the number of samples examined and the number of positive results obtained in each month throughout the year.

Table 2.

Month	Total Number of Samples tested	Number of Samples containing Inhibitory Organisms
April, 1934	21	1
May, 1934	25	2
June, 1934	24	0
July, 1934	26	3
August, 1934	26	0
September, 1934	25	5
October, 1934	26	5
November, 1934	26	1
December, 1934	18	5
January, 1935	23	13
February, 1935	20	7
March, 1935	26	9

It is evident that although there were never large enough numbers of inhibitory streptococci in the milk to cause any trouble in cheese-manufacture, yet on many days the organisms were present in small numbers. The results also show that the organisms tended to occur more frequently in the summer months.

OCCURRENCE OF INHIBITORY ORGANISMS IN MILK FROM INDIVIDUAL COWS.

The next step was to determine whether the inhibitory streptococci present in the mixed milk-supply on certain days were derived from within the udders of some of the cows or were the result of contamination during the milking process. Samples were therefore drawn by hand from single cows, with precautions against contamination. The udder was thoroughly washed with water and then with a hypochlorite solution. Two streams of milk from each

quarter were rejected, and samples were taken in sterile bottles or tubes held almost in a horizontal position during the short time it was necessary to have the containers open. Almost all the cows from the herd (which reached a maximum of 115) were examined, some of them several times: several hundred samples of milk were tested in all. Inhibitory organisms were found from time to time in the milk of fifteen cows. Positive results were not obtained regularly with any one animal, and in the majority of cases the organisms were found only at rare intervals; but in the case of one animal seven out of thirty-two examinations (three within an eight-day period) gave a positive result. This case alone seems to exclude the possibility of the occurrence of the inhibitory organisms being due to contamination of the milk from outside sources due to a faulty technique in drawing the samples.

The results indicate, therefore, that inhibitory streptococci existed within the udder (or teat canals) of certain cows. Their relatively infrequent detection in many instances may have been due to the limits of sensitivity of the method used, since, as has already been mentioned, the numbers of organisms present in the freshly drawn milk were evidently extremely small, and the survival and growth of the few bacterial cells present must have depended to some extent on chance conditions.

An examination of the records of the cows in the herd gave no indication of any correlation between udder-disease and the occurrence of inhibitory streptococci. Of the cows suffering from mastitis, some yielded inhibitory organisms in the milk and some did not; the same held true for cows which had never suffered from mastitis. The previously mentioned considerations with regard to the limitations of the method of detection apply here also; yet if there were a definite connection between the inhibitory streptococci and udder-disease one would have expected to find the organisms in greater numbers and more constantly in diseased udders.

Examination of various Materials for Inhibitory Streptococci.

Various possible sources round a milking-shed were investigated in an attempt to find inhibitory organisms elsewhere than within the udders of cows. The outside surface of udders, cow-hairs, cow-dung, water, and ensilage were all examined.

Flasks and beakers of sterile milk were placed under the udders of cows, and in some cases the udders were rubbed so as to cause dust to fall into the vessels below. Sterile swabs of cotton-wool were rubbed on the surface of udders and then immersed in sterile milk. In all cases the milk was incubated at 30° C. until clotting took place, when examination by the methylene-blue method was carried out. Inhibitory organisms were detected in four out of sixty-five samples.

No inhibitory organisms were detected in four experiments in which hairs from the udder and tail were immersed in sterile milk.

Seventeen samples of water drawn from various points around the milking-shed all gave negative results.

Two samples of cow-dung out of fifty examined gave positive results.

Mr. W. H. Udy's observations on the occurrence of inhibitory streptococci in silage were confirmed. Positive results were obtained in three out of five examinations.

It is evident from the above results that the inhibitory streptococci are widespread, but that in all the materials so far examined they occur only irregularly and in small numbers. They are thus similar in their occurrence to *Str. lactis* and other normal lactic streptococci.

DISCUSSION.

It is apparent that inhibitory streptococci in small numbers may find their way into a milk-supply either from within the udders of certain cows or as the result of contamination of the milk from several outside sources. In daily samples from a good-quality supply the organisms were found more frequently in the summer than in the winter. This is readily understandable. More cows are in the herd in the summer, and thus there is more chance that at least one animal is delivering milk containing the organisms. Moreover, in the warmer weather there is more chance of the streptococci establishing themselves temporarily in the milking-machine, even though it be carefully cleaned. Yet another possibility is infection of the milk from silage fed to the cows. The large number of positive results obtained in January, 1935 (Table 2), may have been due to this factor.

But the number of inhibitory streptococci present in milk produced under careful conditions and cooled adequately could never be sufficient to cause any trouble in commercial practice. Trouble occurs only where the organisms are allowed to find a secondary habitat in the machine and utensils so that each batch of milk which passes through the machine is heavily inoculated. Inadequate cooling then permits growth to such a degree that the inhibitory products render the milk unsuitable for the growth of a normal "starter." It seems probable that the inhibitory streptococci are as widespread as the normal lactic streptococci. At any rate, the investigations described here failed to demonstrate any sources where the organisms occurred regularly in large numbers.

SUMMARY.

Streptococci which produce a substance inhibitory toward normal lactic streptococci occur quite frequently in small numbers in normal milk-supplies. An enrichment technique enabled their presence to be demonstrated simply and quickly. An attempt to determine the source of the organisms showed that they probably existed within the udders of some cows, and that they could also be found in cow-dung and silage, and on the coats of the animals. In all these sources they occurred irregularly and in small numbers. A correlation could not be detected between the occurrence of inhibitory streptococci in the milk and the incidence of udder-disease in the cows.

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(1) WHITEHEAD and RIDDET (1933): *N.Z. Jour. of Agric.*, 46, 225.
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SURVEY OF PRODUCTION OF IRRIGATION FARMS ON GALLOWAY FLAT, CENTRAL OTAGO.

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PRIOR to irrigation Galloway Flat was practically unproductive, with a carrying-capacity of possibly one sheep to 10 acres, the vegetation consisting mainly of scab-weed (*Raoulia lutescens*) and odd stunted tussocks. The rainfall is about 12 in. per annum, with the majority of this falling during the winter months, when the temperature is often below freezing-point for many days on end, while in the summer the average temperature is above that of most parts of New Zealand, averaging from 75 to 85 degrees F. during these months.

With the advent of irrigation the scene of Galloway Flat has changed completely, from a semi-arid and barren region to a good dairy-farming district carrying splendid pastures and good lucerne stands.

The data in Table 1 have been obtained from seven dairy-farms and one sheep-farm on the Galloway Flat.

Table 1.

Actual Area, in Acres.	Area in Lucerne, in Acres.	Total Area in Grass	Area of Grassland closed up for Hay.	Area in Roots, &c.
18	3½	14½	4	..
92	18	74	..	..
90	20	57½	..	2½
65	18	47	..	¼
65	20	45	..	..
92	18	74	4	..
52	10	38	4 red clover	¼
55	..	45	10 red clover	..

The feeding of stock usually commences early in June and continues until well into September, and, as can be seen from Table 1, lucerne hay is the main fodder, and it is supplemented with a little grass or clover hay. On three of the above farms the first cut of lucerne is converted into silage. All the lucerne is saved for winter feed, except, possibly, the short growth produced after the last cut, which may be grazed off. Up to the present, roots have not been grown to any extent, and the roots that have been produced are usually fed to pigs. Good crops of both mangels and carrots are grown successfully, and root-growing will probably become more of an established practice on the Flat.

The 90-acre farm with its 30 acres of lucerne is the only one in a position to sell hay, and it does so each year. With a third of its area in lucerne it is practically the only farm which each year has definite reserves of hay or silage.

MANAGEMENT AND PRODUCTION OF FARMS.

Table 2 gives data relative to the production and general working of the above farms, and, as a common basis is required on which to make

comparisons, Table 2 has been based on a 100-acre unit. Consequently a per-acre figure is readily obtained by shifting the decimal point two places to the left.

Water.—This naturally varies, depending on the class of land, crops grown, and the depth of loam which is covering the gravel subsoil. Where the gravel actually comes to the surface, a large volume of water is required to cover the field. On the eight farms an average of 116·8 day cusecs per 100 acres have been used, this being equivalent to 27·75 in. The water used ranges from 0·83 cusecs to 2·11 cusecs per acre, or 19·72 in. to 50 in. of water per acre.

The 18-acre farm demonstrates the fact that a relatively small area can be irrigated more economically than a larger area, provided the soil-type is the same, because a smaller head of water is required and the work of distribution can be dealt with more effectively.

Again, on the 52-acre farm 2·1 cusecs have been used per acre, in comparison with 0·8 cusecs per acre on the 18-acre farm. This is found to be due mainly to the fact that the shingly subsoil reaches the surface over a comparatively large area of the 52 acres. None of the other farms have the same relative area of gravel or shingly soil coming to the surface, and this is reflected in their consumption of irrigation water.

The systems used for irrigating are —(1) Border-dyke on all the flat areas, these having been laid down in permanent pasture—lucerne or red clover ; (2) on the permanent-pasture slopes which rise up on the side of the flat, flooding from contour ditches is carried out ; (3) Furrow-irrigation is carried out in producing root crops and in vegetable gardens, &c.

Butterfat.—Butterfat production has been calculated from the actual factory returns only. The average production per 100 acres is 12,484·3 lb., or 124·8 lb. per acre. The range in production per farm is from 88·6 lb. to 166·6 lb. per acre. Here again the small holding shows to advantage in butterfat per acre, and also in cows per acre, although the average butterfat per cow is beaten by three other herds. The high butterfat-per-acre figure of the small farm is due to smaller paddocks allowing intensive and rotational grazing, which gives more efficient control of pastures. On the larger farms the management is not so intensified, and as the season advances the grass-growth tends to become tufty with roughage or tends to get ahead of the stock, thus losing some of its nutritive value as compared with short well-controlled pastures.

The average butterfat per cow is 245·5 lb., and the range is from 192·25 lb. to 283·5 lb. per cow.

Stock carried.—The average number of stock carried was 49·7 dairy cows, plus 37·9 dry stock (which includes horses). Only one dairy-farm carried sheep, and this at the rate of 78·8 per 100 acres. The average number of pigs carried was 19·5 per 100 acres, or 1 pig to 2½ dairy cows.

Stock-food.—Very little stock-food was bought or sold. Good supplies of hay and silage are produced on the holdings, and these form practically the only source of winter fodder.

Fertilizer.—Superphosphate is the only fertilizer used and the use of this is not really general, as any response from superphosphate is usually masked by the large response always obtained from irrigation. The

Table 2—Farm Data, calculated per 100 Acres.

Actual Area, in Acres.	Actual Number of Workmen.	Water Day-cusecs.	Total Butterfat, in Pounds.	Butterfat per Cow.	Number of Milk Cows.	Number of Dry Stock, including Horses.	Number of Pigs.	Number of Sheep.	Stock-food bought or sold.	Fertilizer used, in Tons.
18	1	83·3	16,666·6	250·2	66·6	51·4	..	..	..	..
92	3	125·0	13,554·3	283·5	47·8	25·0	13·5	78·8	Bought 4·3 tons hay ..	..
90	2	103·3	13,577·0	271·5	50·0	42·2	29·3	..	Sold 18·8 tons hay ..	..
65	2	104·6	8,863·0	192·25	46·1	76·8	21·5	..	Bought 0·77 tons oat dust	..
65	2	104·6	9,860·0	200·4	49·2	13·8	30·7	..	..	3·1 tons super.
92	3	102·5	13,254·3	312·4	42·4	41·0	12·5	..	..	6·5 tons super.
52	2	211·5	9,615·3	208·3	46·1	15·3	29·4	..	..	..
55	1	100·0	..	..	..	..	..	515·09	..	3 tons super.
529 (totals) ..	..	934·8	87,390·5	1,718·55	348·2	265·5	136·9	..	..	..
66 (averages) ..	..	116·8	12,484·3	245·5	49·7	37·9	19·5	..	..	..

soils of Central Otago have been derived mainly from mica-schist, and different writers* have shown that the amounts of lime, potash, and phosphoric acid in these soils are particularly high, and that practically all that is required at present in these highly fertile soils is water.

SUMMARY.

Because of irrigation there is being produced on 100 acres of the Galloway Flat by two to three men 12,484 lb. of butterfat annually from 50 cows. In addition 38 dry stock, 20 pigs, and 10 sheep are being carried with practically no stock-food bought and only a little fertilizer used.

On the farm which runs only sheep, the carrying-capacity for the year is 5·15 sheep per acre. Actually it is much higher than this during those months when the lambs are being carried and fattened. The procedure followed is to buy ewes at the autumn sales and carry them until about the following February, when both ewes and lambs are sold off the pasture as fats. The farm is then given approximately two months complete spell until ewes are again bought in at the autumn sales.

(In the above figures are included all the young stock produced or sold during the year, and these are estimated as twelve months old by the addition of the total ages in months divided by 12—*e.g.*, 60 lambs at five months old equals 25 sheep, or 20 porkers five months old equals 8⅓ pigs.)

* N.Z. Department of Agriculture Bulletin No. 120, by Tennent and Marks, pages 6 and 7.

The Instructor in Agriculture, Dunedin, reports that at Palmerston South certified seed of Arran Chief potatoes yielded a 50-per-cent heavier crop than uncertified seed of the same variety grown in adjacent rows and treated similarly.

Certified Cocksfoot grown on Akaroa Peninsula.—In an article on seed certification published in the *Journal* for November, 1935, a comment in regard to cocksfoot-seed on the Akaroa Peninsula requires re-wording to prevent misinterpretation. The third sentence in the first paragraph under this heading should read: "The proportion of seed certified on the Akaroa Peninsula, under the immediate supervision of the Akaroa Cocksfoot Growers' Association, *in relation to the total quantity certified in New Zealand*, has fallen considerably, despite the fact that the total *certified* produce from this district shows a considerable increase."

SEASONAL NOTES.

THE FARM.

Management of Established Pastures.

CONSIDERABLE field experience indicates that over a wide range of conditions some at least of the pastures on farms usefully may be top-dressed with phosphates during the latter part of summer or in autumn. Rain may be expected at this period, but, if dry conditions prevail, the action of the phosphates simply is largely deferred. On the other hand, if the rainfall is adequate, such application of phosphates immediately stimulates additional growth and puts the farmer in a stronger position for facing the critical winter period. Further, the phosphates, even superphosphate, which is of quickest action, when applied in the fall are not exhausted quickly, but bring about materially increased growth during the following spring and summer. When transport and distribution of fertilizers in the spring are likely to be hampered by wet conditions, as, for instance, in some hilly country, and when the prospective supplies of winter and spring feed are scant, fall top-dressing becomes particularly desirable. Similarly fall top-dressing is proving very effective in some relatively severe dry districts, such as parts of Canterbury, where a substantial portion of the summer and autumn is characterized by light-rainfall conditions under which fertilizers have little or no effect on growth of pastures.

About February, mowing of grassland may be advisable because of various circumstances. There may be a need to remove the flower-heads of perennial weeds, or there may be a need to " top," by light mowing, portions of pasture-growth which are rank and producing seed, in order to bring about the development of fresh leafy growth from the base of the topped plants. Sometimes, and especially after a winter or spring in which poaching or over-grazing takes place, pastures are overrun by large numbers of shade-creating weeds such as spear thistles, docks, fat-hen, and red-shank or willow-weed. If these weeds are ignored they are likely to weaken greatly the pasture-plants in their vicinity and probably create vacant patches on which inferior plants become established eventually. Mowing of them, however, minimizes their shading effect by which they injure the valuable pasture-plants.

A widespread need continues to be increased attention to the quality of the production of the pastures in the latter part of summer. In January and February usually any weakness in pastures as a source of feed for " wet " stock is more likely to be on the score of quality rather than of quantity, and the lack of quality is correlated with the stemminess in the growth which is so common. Both the top-dressing and the " topping " in the manner described above tend to obviate the stemminess and to induce fresh leafy growth. The more special non-woody crops, such as soft turnips, green lucerne, millet, &c., are dispensed with the greater is the need to take measures which provide the greatest practical amount of leafy growth on pastures. The more grassland is depended upon as the direct source of feed the greater is the likelihood of late summer proving a critical period in live-stock husbandry, and particularly is this so in dairying. The use of silage at this season serves to relieve the position to some extent, but silage as normally available contains so much stemmy material that it is far from ideal as the dominant constituent in the rations of cows of fairly heavy to heavy production—a fact which has been well demonstrated in dry summers when acute lack of other feed has forced farmers to feed silage freely to dairy cows

Pasture Establishment.

The preparation of the ground for autumn sowing of pastures is an important summer task to which considerable reference was made in these notes last month. Lack of fineness and firmness of the seed-bed are common causes of poor results in pasture establishment. Fineness, and particularly firmness or consolidation, cannot be secured readily unless the work is commenced in good time. Clovers, which are essential in successful permanent pastures, call especially for consolidation

Recent years have been marked by a changed outlook in respect to the constitution of pasture seed-mixtures for use in districts which enjoy a rainfall suited in its distribution and amount for effective use of fertilizers on grassland—such is the rainfall of much of New Zealand apart from the particularly dry districts. The natural plant-food supply of the soil has declined in importance as a consideration, when deciding upon the composition of a pasture seed-mixture : this is because, when rainfall is not the limiting factor in production, the original fertility of the soil can be altered so readily and radically by top-dressing that often the ingredients that should be used in a grass-seed mixture become dependent more upon the proposed top-dressing programme and the rainfall than upon the natural fertility of the soil. It often proves advisable to bring the fertility of the soil up to the requirements of a high-class seed-mixture by appropriate top-dressing rather than to use a seed-mixture with lower requirements co-ordinate with the natural unimproved fertility of the soil As an illustration of this, land the fertility of which is more fitted to the requirements of cocksfoot and dogstail than those of rye-grass at times may well be sown with a mixture suited to provide a rye-grass-white-clover-dominant pasture, it being intended to increase the standard of fertility to rye-grass requirements and to maintain it at this standard by suitable top-dressing Because of the change in outlook seed-mixtures which were considered the best a few years ago for certain conditions may not now be so considered. Farmers at all uncertain on this matter are likely to find it well worth while to seek the guidance available from district officers of the Fields Division of the Department of Agriculture One of the principal matters in this connection is that proven superior strains of important pasture species are commercially available, and that if these species are to be used it is exceptional for the use of anything but the proven superior strains to be justifiable economically

In general, because there are now available better seeds and a greater knowledge of top-dressing, it is reasonable to expect that pastures intended to be as permanent as possible will be of longer profitable life in the future then they have been at times in the past It follows from this that the preparation of the seed-bed and the composition of seed-mixtures are now of greater importance than formerly- any weakness creeping in at the outset will exert its undesirable influence over a greater number of years

Where the grass-grub has been in evidence it calls for consideration. The more herbage land carried during the period November to January the more is it likely to be infested with grass-grub, and so, in districts subject to grass-grub depredations, it is not altogether desirable to sow down pastures after a cereal or a previous crop of grass

Some Measures to Control Rushes.

While the desirability of mowing certain weeds has been mentioned above, mowing as a means of controlling rushes has some special features that call for particular mention. When the ingress of rushes is due primarily to persistent bad drainage, then one can expect to effect little in the control of the rushes simply by mowing them. But it is to be borne in mind that the presence of rushes even in considerable numbers is not necessarily due to poor drainage. In some instances rushes have obtained

a foothold in pastures on fairly well-drained land right at the outset because of some degree of failure during the early stages of establishment due to, for instance, the use of seed of poor germination capacity. Similarly, on land of quite good drainage the use of seed of a non-persistent strain has been associated with the early ingress of rushes on grassland, whereas rushes have not established when seed of a persistent strain has been used. Again, rushes have freely invaded pastures of considerable age on reasonably well-drained land when these pastures have become weakened and more open because of lowered soil fertility or of prolonged periods of over-severe grazing. The fact that pasture-management factors apart altogether from drainage may greatly influence the amount of trouble from rushes is at times well illustrated in the field when adjacent to a pasture practically free from rushes occurs another pasture heavily invaded by rushes despite the fact that the drainage of the two pastures is practically similar. Mowing of rushes not due essentially to bad drainage has been tried fairly extensively with varying results. Such mowing of rushes in January or early February has proved of substantial service in controlling them, while mowing at a considerably earlier or later date has been much less effective. It would seem that in the Manawatu district, at least, rushes are most susceptible to weakening by mowing shortly after midsummer, and, while it is likely that what applies in the Manawatu applies also in most other districts, only actual field experience can provide definite information on the point. The good results noted in the control of rushes by mowing have been obtained only when mowing at a suitable date has been accompanied by conditions which maintain or produce a vigorous sward with a tendency to become more dense rather than more open. Hence good results are not to be expected from the mere mowing of rushes invading an open somewhat weak pasture. On the other hand, mowing of a sward which has been invigorated by top-dressing and on which good grazing has been practised, while not eradicating the rushes, has reduced their development so much as to bring about practical control of them—the small clumps of rushes that continue to persist do not influence materially the growth of the pasture. In short, the economic control of rushes at times is to be obtained not directly by any one measure such as mowing or top-dressing, but by several measures interacting in such a manner that the rushes are weakened by, say, mowing at about the same time as the pastures are strengthened by top-dressing and rational grazing treatment.

Control of Weeds in Summer.

Often during summer it proves decidedly profitable to give attention to certain measures which assist in bringing about the control of weeds: this applies particularly to farms on which land is under the plough.

At times, and especially in the South Island, weeds should be considered when future cropping is being planned. For instance, land may be foul with annual weeds such as fat-hen, spurrey (yarr), and nightshade, which germinate in the spring and early summer rather than at other seasons. Cropping should be arranged, if at all practicable, so that such land is sown in the autumn instead of in the spring. The influence of date of sowing on weed control is well exemplified when wheat is grown on land infested with seeds of fat-hen: usually the fat-hen is not much in evidence in autumn-sown wheat, while it is likely to be prominent in spring-sown wheat. Similarly, turnips or spring-sown oats may be badly affected by spurrey, whereas autumn-sown oats or temporary pasture may receive no injury from this weed. Further, it should be remembered that if trouble from annual weeds is avoided for one season by autumn sowing, the land does not thereby become free from weed seeds: field experience shows forcibly that the seeds of many weeds including fat-hen, spurrey, and nightshade, are capable of persisting alive and vigorous when buried in the soil for many

years. Because of this, land which is known to be foul with seeds of weeds should be kept in pasture, if the pasture is satisfactory, as long as it is practicable to avoid ploughing it.

Certain crops such as potatoes, mangels, swedes, and carrots, which are grown in rows wide enough apart to allow of intertillage, have been called "cleaning" crops, because of the opportunity they offer of getting rid of weeds. Such crops should be made "cleaning" crops in fact as well as in name: often they are cleaning crops in name only, since once the main invasion of weeds has been dealt with succeeding invasions, which are sufficient to foul the land badly even if they do not appreciably lower the yield of the crop, are neglected. Often February is the time when such neglect occurs.

Summer fallowing is at times recommended as a standard means of exterminating weeds generally. Actually it has been dispensed with widely because it is impracticable as a sole means of destroying weeds difficult to deal with: except under the conditions most favourable to it, and these are not of wide occurrence, it is likely to be both expensive and disappointing. Usually the summer fallow is recommended for and has been employed against "twitchy" weeds such as couch-grass, brown-top, creeping-fog, sorrel, yarrow, and Californian or creeping thistle. Experience has shown definitely that, while summer fallow at times may lead directly to the eradication of such weeds, it requires so much labour as usually to become too expensive even when successful, and, further, that in many cases no matter how much labour were devoted to summer fallow it would not be effective enough.

From this it is not to be deduced that summer cultivation is useless in weed control. The position is that summer cultivation should be succeeded by other suitable practices to obtain the fullest possible value from it. For instance, summer cultivation during a dry period may considerably weaken a perennial twitchy weed, but on the return of moist conditions the twitch may become vigorous and give trouble again unless it is subjected to further weakening. Hence the summer cultivation during a dry period should be followed by the immediate sowing of a crop which grows quickly and densely. Such crops have a weakening effect by excluding direct sunlight, which is of as vital importance to practically all weeds as it is to farm crops generally. At times autumn-sown Algerian oats or Western Wolths rye-grass and red clover prove suitable for this purpose. If after such a crop the weeds still call for further weakening, it may be advisable to grow a well-nourished well-tended forage crop, such as chou moellier, rape, mangels, turnips, &c., which is able to compete successfully with the weeds for the supply of direct sunlight. In short, a suitable rotation of crops which all the time pays its way and which is spread over a number of seasons rather than expensive summer fallow is the economic modern method of eradication of perennial weeds.

Sometimes, as in the case of old pastures, it is known that the surface of land is badly infested with seeds of weeds. Such land, having been ploughed, should be so cultivated subsequently that the buried former surface layer is not again brought to the surface. While seeds of weeds which are buried to a depth of several inches may not be destroyed, they do not germinate, and as long as they do not germinate they do not affect crops. This point is of considerable moment in the preparation of land for such crops as mangels, lucerne, and carrots, which are particularly apt to suffer from weed-infestation.

Often indirect attack on such weeds as sorrel, brown-top, creeping-fog, and similarly "twitchy" weeds is most advisable. Suitable indirect attack often consists of sowing the land in pasture and then by appropriate top-dressing and management making the conditions so favourable to the pasture that eventually the valuable species outgrow the weeds to such a degree that the weeds, while not eradicated, are of little or no consequence.

The Breeding-ewes.

In fat-lamb production in the North Island the rams are usually put out at the end of February or in early March. If there is likelihood of the ewes being too fat, they should be put on scant rations early enough to have their condition appropriately lowered prior to the flushing, which is advisable for a period of a week or ten days prior to the rams going out. Flushing can be effected by providing some succulent feed as by putting the ewes on the best short pastures available or by putting them on rape after the first feeding-off by the lambs.

Work with Crops.

The current work in respect to the utilization of crops and to forage and general cropping is covered broadly in last month's notes. The avoidance of an unduly rapid decline in the daily production of butterfat during February is a task of particular moment. Crops which prove valuable in this task are young leafy red clover, or lucerne before it has developed woodiness and before there is any flower-production, young millet, and soft turnips. By leaving them longer uneaten some of these crops would produce heavier yields. But the returns from a crop are not determined solely by its gross yield. In the first place a light crop, say, 15 tons an acre of turnips, used when it is badly needed may prove more valuable than a heavier crop of from 20 tons to 25 tons an acre used when alternative feed is freely available. In the second place, greater maturity and yield in the case of crops such as lucerne and millet often are linked up with a falling-off in nutritive value of a given quantity of the forage because of lowered digestibility or of poorer balance of ingredients.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Pest and Disease Control.

THE coming few weeks heralds the close of the spraying season Sometimes when the harvesting season commences spraying is neglected and necessary sprays are not applied because it is somewhat inconvenient to apply them at that time. While there may be times when this practice does not result in an increase in disease, it is an unwise risk to take, for more often than not the omission results in greater damage by disease or pest than would otherwise obtain —especially is this true of late infection of black-spot in wet seasons or during periods when dews occur, and of the ravages of leaf-roller caterpillar. The recommendations relative to the treatment to apply during the month are set out in previous months' notes and in Bulletin No 161 entitled " Control of Orchard Diseases and Pests by Spraying," and obtainable from the Orchard Instructor for the district or the Department of Agriculture, Wellington.

Harvesting the Crop.

The importance of care in the preparation of fruit, for either local or export markets, cannot be emphasized too strongly. Considerable losses accrue through faulty handling during the picking, grading, and packing operations.

The picking of the crop, whether it be stone or pip fruits, calls for considerable discretion and care on the part of the picker. Carefully picking to size and eliminating the culls greatly facilitates the work in the packing-sheds. Rejected and fallen fruit should not be allowed to remain on the ground, but should be gathered up, and, if not utilized, should either be deeply buried or destroyed.

Attention must also be paid to maturity, and several pickings should be made, removing the fruits which have reached the required degree of ripeness for the market it is intended to supply. The more distant the market the earlier the fruit should be gathered to ensure its arrival on the market in good marketable condition. In gathering fruit intended for export attention should be directed to the degree of maturity rather than colour. Much has been written about the necessity of picking to colour and colour standards, but this is apt to be misleading to the grower or picker, as, while the fruit remains on the tree to attain a high colour, it may become over-mature for transport to the market

Select early pickings are of great benefit, as the removal of the mature and larger fruits accelerates the sizing-up of those remaining and also tends to improve the colour of such fruit. The fruit should be carefully removed without damaging the fruit spurs or tearing out the stalks from the fruit. When picked, the fruit should not be left standing in the sun, but removed as soon as possible to the packing-shed

Grading and Packing.

Stone fruits require an absolute minimum of handling Where careful pickings have been made it is possible and also wise to grade and pack at the one time direct from the orchard-box.

These fruits should be packed and despatched with a minimum of delay. For good-quality lines of the larger-sized fruit, especially where consignments have to undergo long transit, the use of trays instead of cases is recommended.

The grading of the export crop requires skilled knowledge on the part of the grader. Where labour for hand-grading has to be employed, every endeavour should be made to obtain suitable operators, as a great deal is dependent upon their reliability and quickness If mechanical sizers are in use, the rollers, carriers, belts, bins, fruit-hoppers, &c , should be cleaned once a day in order to remove as far as possible any grit or other material likely to cause scratching and superficial marking of the fruit Scrubbing with a stiff wire brush the parts of the grader with which the fruit comes into contact removes the natural oil of the fruit which adheres to these parts, and which, if not removed, collects dirt and grit and causes the scratching of the fruit

The packing-bins should not be over-filled, as this is likely to cause considerable bruising, skin-punctures, and scratching of the fruit. These injuries are frequently caused by the " raking-down " of over-full bins.

The shed conditions should be of the best, and the layout should be so arranged as to ensure ease in handling and to avoid confusion. Culls and waste fruit should not be allowed to lie about the shed, but should be removed and dealt with in such a way that they do not become a nuisance.

The packer of fruit for export should pay attention to securing a correct pack. The pack should be consolidated as the case is being filled, and this will tend to tighten up the apples in the centre of the layers, as well as firmly settling the fruits in the pockets, with the result that the centre of the top layer will be above the fruit at either end of the case The finished pack should not be more than ½ in. above either end of the case, or more than 2 in. above in the centre. This will facilitate lidding, without bruising the end apples—a somewhat frequent occurrence when the end apples are too high. Cases which are either too low or too high in pack should be rejected and returned for repacking

In reference to packing, the terms " slack," " low," " tight " and " high " packs are often misunderstood. A slack pack is not necessarily a low pack—in fact, it might even show excessive bulge and yet be slack—a point not sufficiently realized. Slackness is the result of failure to consolidate the pack, and when the cases have received some handling the fruit is shaken

into place and a " rattle " develops. A " tight " pack of correct height will not rattle until appreciable shrinkage has taken place in the fruit, while a " high " pack is one in which the height of the bulge at the centre when it leaves the packer is greater than 2 in. above the edge of the case or more than ½ in. at close to the ends of the case.

Before lidding, cases when packed should not be placed on the floor or other flat surface. If this is done the bulge on the bottom of the case is forced up and the pack loosened, and the benefit from the consolidation of the pack thereby lost. Some convenient means of avoiding this usually can be devised readily.

The wiring, labelling, and stamping should be carried out with care, to ensure that the package has a neat and tidy appearance.

—*R. G. Hamilton, Orchard Instructor, Hamilton.*

Citrus Notes.

On account of the possibility of a dry period being experienced, every effort should be made to conserve as much moisture as possible. This can be done best by maintaining a clean state of cultivation and by working the soil to a depth of from 3 in. to 4 in. as a mulch Wherever possible rough litter such as dry hay, straw, &c., may be spread over the surface of the rooting-area, but should not be allowed to come in contact with the tree-trunk. This material prevents excessive evaporation, assists in maintaining a more equable soil temperature, and eventually becomes available as a plant-food when it decays and becomes incorporated in the soil.

In some groves irrigation may be necessary. As citrus trees make their greatest demand on the water-content of the soil during the period when a minimum rainfall is usually experienced, steps should be taken to ensure that sufficient moisture is provided. Without the necessary moisture satisfactory growth and fruit-development cannot take place. All fruit sufficiently matured should be harvested so as to give the trees every chance to set the coming crop, otherwise much young fruit will drop which would have remained on the tree to produce a good spring crop

On young trees where extended growth has taken place pinching should be carried out so as to force an early subdivision of leaders. If left to mature without attention vigorous shoots often grow to a length of 3 ft. or more before dividing, and eventually leave an undue length of wood unfurnished.

Should humid conditions prevail, it will be necessary to apply a further Bordeaux (3–4–50) spray as a check to verrucosis on the maturing crop.

Where red-scale is prevalent January is the month to apply the first spray of summer oil (1–33), mentioned in September notes.

—*L. Paynter, Orchard Instructor, Auckland*

POULTRY-KEEPING.

General Considerations.

RECENT statistics showed that 154,221 persons, or approximately 50 per cent. of the householders in New Zealand, kept poultry. The returns further showed that 117,988, or approximately 77 per cent., of those householders kept under 25 fowls, and only sixty-six householders kept 1,000 fowls or over at that time.

The indication is that the greater bulk of the eggs and poultry produced in this Dominion comes from the farmers or small producers, and this no doubt will continue to be the position, although in recent years there appears to be a tendency in certain centres for more people to take up poultry-keeping on a larger scale.

If it is intended to take up poultry-keeping on a commercial scale the selection of site calls for very careful consideration. The ideal class of soil on which to keep poultry is a sandy loam with a gravel subsoil—a soil which produces a good growth of grass, the gravel subsoil allowing of a good free drainage. It is an advantage to have a site which has a slight slope to the north, and which is sheltered from the prevailing bad weather by either natural shelter or a belt of trees. Such ideal sites are, of course, not easy to find, but it is well to bear in mind that environment plays a very large part where poultry are concerned, and heavy damp soil or exposed bleak situations should be avoided. Even on some farms where only a comparatively small flock of birds is kept, if more consideration were given to the selection of the site for the poultry-houses and runs the poultry-keeping would, in many cases, prove a more profitable and interesting venture.

Another point that requires careful consideration when selecting a site for a plant is the distance from a good market and the average price of foodstuffs in that particular district Generally speaking, the profit over the cost of production, even under the most favourable circumstances, is such that if valuable time has to be taken up in the carting of produce to and from the market, instead of attending to the more important work of production, or if heavy freights have to be paid, much loss may result.

Experience has shown that the most successful poultry-farmers are amongst those who have either started by keeping a few fowls as a hobby and gradually built up their flock as experience and knowledge were obtained, or who first spent some time on a successful poultry-keeper's plant before starting out in business on their own account Unfortunately some have started in the business and found that they were unable to make a success of the venture, and in a number of such cases those concerned have failed to appreciate the fact that poultry in large numbers is one of the most difficult classes of live-stock to handle profitably, or that poultry-farming is a highly skilled occupation, and is even more dangerous financially to undertake without experience than other branches of production It is desirable if a person wishes to take up poultry-keeping on a commercial scale to first obtain some practical experience on the run of a successful poultryman, or start in a small way and gradually build up as knowledge and experience grow.

Culling.

One of the most important jobs a poultry-keeper should learn is how to cull his flock correctly Generally, February is about the best month during which to undertake the main culling for the year, as few, if any, of the good birds should have started to moult by that time Many poultry-keepers now realize the value of culling, and most of the successful commercial men cull regularly throughout the year, as this has been found necessary in order to keep the flock on the best paying basis. A number of poultry-keepers cull only once a year, during the autumn, because they do not feel satisfied that they could make a satisfactory job of the business at other times.

The art of culling is not simple, as it calls for keen observation, much practice, and experience It really means the balancing or correctly weighing of the various points, as no one point or factor can be depended upon under all conditions. For instance, the early moulters are usually looked upon as weak birds and poor producers, but if a flock has been underfed, or subject to any sudden change of feed, say, about December, many good birds may have been forced into an early moult. Therefore such points must be taken into consideration when estimating the producing-capacity of such birds

The most difficult flock to cull correctly is one that has been mismanaged at some time during the year, and contains birds of various ages, and it is

only a person with considerable experience who is likely to make a satisfactory job of the culling. Provided the birds have been well cared for, the following factors are worthy of attention when culling: The first thing to look for in any bird is a good constitution, and as physical activity is one, if not the chief, evidence of vitality and health, this characteristic should be given first consideration. It will be found that birds of good constitution are quick in movement, constantly on the hunt for feed, and are the first off the perch in the morning and last on at night. In fact, they never seem satisfied with what is given them, and if on free range will often be farther away from the fowl-house at dusk than other birds.

On the other hand, birds of poor constitution and invariably poor producers are generally slow-moving and sluggish, spend a good deal of time on the perch, and are either over-fat or too thin. Such birds should be culled.

The time of moulting is the next important factor, for experience has shown that the best producers are usually the last birds in a flock to shed their feathers, so birds that are still laying at the middle of February may be retained for a further period, provided, of course, that they are not over two and a half years old, while those going into a moult before this period may in most cases be culled.

The heavy producers and those that may be retained for a further period will possess the following characteristics: Comb fairly full, warm, waxy, and red. Eyes large, bright, full, and prominent. Abdomen is deep, at least three fingers' width between the pelvis and end of the keel bone, with texture soft, thin, and pliable. The pelvic bones are thin and flexible, with a spread of at least two fingers' width between them. The vent is large, moist, and of a flesh or pinkish colour. With Leghorns and other yellow-legged breeds, the beak and legs are of a pale or flesh colour at this period of the year. Feathering is hard, tight, dense, and often of a worn threadbare appearance, while many good Leghorns have a more-or-less straw-like tinge in the feathers towards the end of a heavy laying period. The poorer birds and those not producing, usually may be detected by the following characteristics: Comb small or shrunken, cold, and more-or-less hard. Eyes small, listless, and sunken. Pelvic bones thick, coarse, and stiff, with less than two fingers' width apart. Vent dry and small and puckered. Abdomen shallow, with less than three fingers' width between the pelvic and breast or keel bones. At times some birds of the heavy breeds may show depth of abdomen, but the texture, with poor producers, will generally be found to be coarse, with a layer of fat beneath the skin. If over-fat, Leghorns and other yellow-legged breeds can usually be picked by their yellow legs and beaks at this time of the year, and such birds should be culled. However, allowance must be made for any birds of the yellow-legged heavy varieties if they have been broody, for the colour usually returns to the beak and legs when a bird is sitting.

Since the inauguration of laying competitions in this country during 1905, where birds are individually tested, much useful and interesting information has been obtained. Not only have we learned the wonderful producing-capacity of the hen when kept under suitable conditions, but, largely as a result of these tests and a careful study of the winning birds by keen observers, much knowledge has been gained, and if poultry-keepers who live in the vicinity of centres where these tests are being conducted could visit the grounds and observe the chief characteristics of the leading birds, they would no doubt observe points which would assist them when culling their own flock.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Extracting Operations.

EXTRACTING should now be in full swing in all districts of the Dominion. Where for any reason operations have been delayed, care must be taken to see that the bees are not crowded, or they will commence to loaf, and the ultimate crop will be small. It is a good policy to extract twice during the season, but where the beekeeper prefers to leave the work until the end of the flow a close watch should be kept so as to provide ample room. This, however, can be done only where large numbers of spare combs are kept on hand. It is during the season when honey is coming in freely that the beekeeper realizes that his most valuable asset, next to his bees, is a good stock of extracting-combs. Every effort should be made to get at least twenty spare combs for each hive in the apiary, and with this number on hand the bees are not likely to be hampered for room.

In the absence of plenty of drawn-out combs the best plan is to keep the extractor going, and thus prevent the bees from blocking the brood-combs. This usually happens unless ample room is provided, and, as a result, the queens are prevented from laying to their utmost, and the colonies dwindle. At no time during the working-season should the work of the queen be hindered. Care must be taken at all times to attend to this important item during the flow. The honey is quite ready to extract when the combs are three parts capped, but great care must be exercised not to extract unripe honey. Numerous instances have come under my notice where the taking of unripe honey has meant a total loss to the beekeeper.

Removing Honey from the Hive.

The usual practice followed when the time for extracting is at hand is to remove the frames one by one. If excluders are used much time will be saved in picking over the combs. As the combs are taken from the hive it is necessary to shake off the bees in front of them, to brush off any remaining bees, and to place the combs in a super for removal to the honey-house. The combs should be covered with a cloth which has been previously placed in water containing a small percentage of carbolic acid. When the season is at its height very little trouble will be experienced from robbers, but in case of a stoppage in the flow precaution is necessary At all times the beekeeper should study his working-equipment, and this is highly important when removing the honey. It will be found convenient to provide a good barrow or truck for carrying at least two full supers. Much time and labour will be saved, and the tedious work of removing the honey will be facilitated.

Straining.

Some form of strainer should be used to catch the larger particles of wax, dead bees, &c., in the honey as it leaves the extractor and before it finally reaches the tank. It is a simple matter to strain the honey, and yet this important part of the work receives less attention than its importance demands. It should be the aim of every beekeeper to see that his product is rendered as marketable as possible before it finally reaches the customer. Wax is not a component part of honey, and dead bees are foreign matter, and yet they are frequently found in honey exposed for sale. Honey containing either is not likely to suit the buyer, and its selling-value is consequently reduced.

To ensure that all but the smallest particles of wax are removed, the honey should be run through a fine wire strainer, and finally passed through fine cheese-cloth before entering the tank. Cheese-cloth strainers are cheap and easily made, and should be cleansed after each day's operations. The strainers should be of such construction as to be easily cleaned, and if

the cloth is tacked into wooden frames the operation is greatly facilitated. Cold water should be used when cleansing the strainers; hot water melts the particles of wax, thereby clogging the holes in the cloth, whereas cold water removes all wax from the surface. It is advisable to hang the strainers up to dry, so that they are ready for use when required.

Good Honey-tanks essential.

No part of the apiary equipment is of more importance at extracting-time than a good tank. From the strainer in use it is advantageous to run the honey into a tank, so that the small particles of wax that pass through the strainers rise to the surface, when they can be skimmed off before finally the honey is drawn off at the bottom of the tank. Many beekeepers run their honey directly from the strainers into tins and small packages ready for sale, with the result that the small particles of wax rise to the surface, to the detriment of the honey and its sale. Frequently complaints are made about the quality of the honey, and not infrequently adulteration is suspected through an excess of these wax particles rising to the surface. Such honey should not find its way to market, its condition having been brought about by sheer neglect on the part of the beekeeper to provide adequate tank accommodation. By allowing the honey to settle in the tank the air bubbles escape, the small particles of wax rise to the surface, and in dry weather surplus water is evaporated.

The size of the tank to be adopted must be decided by the beekeeper himself, as it is hard to find two beekeepers with requirements alike in this matter. He must study his needs and convenience, but in any case the tank should hold enough to enable him to deal with the honey in the hives at the time of extracting.

Examination for Foul-brood.

Opportunity should be taken when removing the surplus honey to make a searching examination of the brood-chamber for disease. In this matter the beekeeper should ever be on the alert, and if disease is noticed in any of the colonies the surplus honey from these colonies should be set aside to be extracted when all other extracting is finished. Many beekeepers spread the trouble by careless handling of diseased colonies at extracting-time. The combs from infected hives should be sterilized with a 20-per-cent. formalin solution or destroyed after the honey has been extracted.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

THE warm soil and occasional showers experienced during the autumn months encourage vigorous growth in young crops, and close attention is required to make the most of this opportunity. Many kinds of weeds reproduce only by means of seeds, and where these have been cut or destroyed before seeding the labour and cost of crop-production is greatly reduced. Young crops during autumn and winter require close attention to prevent competition from weeds. Where weeds are controlled, under suitable weather conditions, good growth is maintained until the individual plants in the crop cover the ground and are able to look after themselves to a great extent. Good spacing in which the constitution of the crop and the quality of the land have been considered is an important factor in achieving a desirable result. The crops concerned are chiefly winter crops of savoys, Brussel sprouts, broccoli, cauliflower, kale, leeks, and celery, which have been recently planted out, and late peas, beans, root crops, and salad crops

recently sown. A little sulphate of ammonia on heavy land or nitrate of soda on light land now in many instances gives a desirable impetus to growth. The frequent use of these fertilizers alone produces in the crop soft growth which is often predisposed to the attack of fungous disease or injury by frost. Where their liberal use is considered desirable potash should be included with later dressings with a view to preventing these undesirable results.

Crops of early celery approaching maturity may now be blanched by tying up the leaves lightly; removing suckers and dead leaves; applying such water and fertilizers as may be required; and, when the plants are dry, filling in round them well pulverized soil to a depth of 4 in. or 5 in. The moulding-up process should be repeated at intervals of a fortnight until completed. Self-blanching varieties planted in blocks on land with the surface at the ordinary level require only to have the light entering from the sides excluded to have the desired result. This may be done by placing 12 in. boards, or other material, on edge close up to the outside rows and fastening them securely in position

Crops of spring cabbage and cauliflower for cutting at that season are sown in seed-beds during the month of February. A good strain of seed sown thinly and protected from the attack of pests will provide good plants for setting out about the month of April in a clean well-drained piece of land.

During the month of November the lower leaves on many crops of tomatoes under glass were lost by prematurely drying off It is common and perhaps natural for a few of the lower and older leaves to behave in this manner, but in the cases referred to the great extent of the loss at that season was no doubt injurious to the crop Mycological examination showed that no disease organism was present, and considering all of the circumstances there is little doubt that the condition was due to the plants at some time suffering from a lack of water in the soil The difficulty of supplying this need during the colder months of spring is best met by thoroughly saturating the soil and subsoil shortly before planting out. With good management, especially as regards temperatures, little more water will then be required before the warmer weather arrives, and it can be applied with less danger of chilling the plants

The harvesting of the tomato crop in the unheated glasshouse is now drawing to a close. So soon as it is finished no time should be lost in cleaning the house and preparing the land for another crop. The former is best commenced by sealing up the house and burning screened agricultural sulphur during a windless evening, using it at the rate of 2 lb per 1,000 cubic feet of air space, and placing it in a number of heaps on the floor of the house so as to get a good diffusion of the gas. The next day, after airing the house, the plants are cut off a few inches above the surface of the ground, and, when reasonably dry, they are carried out, with the strings on which they are trained, and burnt. The house is then swept clean and the roots are carefully lifted, examined, and burnt. The knowledge thus obtained, together with the experience gained during the growth of the crop, gives a good idea of the diseases present and the quality of the soil—data upon which the further treatment must be decided. Where sterilization or change of soil is not required, the land can be cultivated lightly and sown in a green crop to be trenched in later. The problem of controlling plant-diseases may be greatly simplified by promptly burning all waste and infected material.

Small and Sundry Fruits.

Recent exchanges report an increasing popularity in Tasmania for the raspberry variety Lloyd George, which gained a high place in the variety trials at Wisley in England. Experiments are being carried out with the black currant varieties Boskoop Giant, Seabrook's Black, and Goliath, which also headed the list in English trials recently.

In warm localities in the north strawberries are planted towards the end of autumn with good results; but elsewhere it is generally best to set out the plants in early autumn as soon as the young plants are available, so that they are well established before the winter season. Soil suited to this crop is heavy, deeply worked, moist but well drained, and quite free from bad perennial weeds—the situation open but warm. With a heavy dressing of blood and bone manure and superphosphate ploughed under, the plants may be set out with good prospects of a satisfactory crop. As with other kinds of fruiting plants, varieties satisfactory in one district are often disappointing elsewhere. Those favoured in the north are Marguerite, Captain Cook, and Helenslea Surprise, while in the south strains of Melba, Laxton's Noble, and Ettersburgh are preferred. Good plants are required for the best results; they are of moderate size, well rooted, free from leaf-spot and other diseases, and of good strain—not spoiled by bad packing or kept too long out of the ground. When the surface of the ground is well graded and the soil settled firm, the plants may be set out about 9 in. apart and from 26 in. to 36 in. between the rows—the wider distance where the plantations are cropped for two or three years, especially where the matted row is favoured or horse-drawn implements are used. After planting it is advisable to take advantage of dry intervals to cultivate the ground lightly and destroy seedling weeds.

Seed of Cape gooseberries may be sown now to raise plants for setting out in the spring. The plants may be raised in boxes and kept in cold frames or cradles over the winter.

The Homestead Garden.

With the commencement of autumn rains the land is soon in condition for cultivation, and a commencement may be made to carry out garden plans which have been prepared. This is done by driving stout wooden pegs in the ground defining walks, drives, and service court, just as they are shown on the plan. These areas are then graded and formed in readiness for metalling, taking special care to destroy or remove all bad weeds. The remainder of the area is then given thorough cultivation to prepare it for sowing down lawns and planting trees and shrubs. This may be done by trenching or double ploughing, whichever is most convenient to obtain a good tilth. It is advisable to destroy all weeds, and to retain the fertile dark loam in its natural position—on top. The aim should be to complete this work in time for sowing lawns during the month of March and planting trees and shrubs during the months of May and June. If this is not possible it generally is best to be ready for carrying out these planting operations about the month of August.

The success attained depends to a very great extent on suitable levels and grades being set for the ground surface. It is generally advisable to make the surface *level* around the foundations of the house and to have a steadily falling grade from the foundations outward, so that all surface water readily drains away and does not lie in the vicinity. Sumps and culverts usually are required to dispose of water on drive and walks. In small gardens levels are set by driving wooden pegs at intervals of from 10 ft. to 12 ft. and adjusting them by means of a straight-edge and spirit-level, and extending them by means of boning-rods. A variety of problems arises in carrying out these tasks, and they should be dealt with by giving them careful consideration, as no other operation is more vital to the success of the undertaking.

Many bulbous and tuberous plants are best planted now; they include narcissus, scillas (bluebells), crocus, muscari (grape hyacinths), iris, and lilies so soon as they die down. In an alkaline soil the bearded irises make a rich display during spring and summer; in such localities they should be a feature in sunny positions. Crocuses—blue, gold, and white—are suitable for planting in turf composed of dwarf grasses; and scillas and

muscari form an excellent contrast with their blue flowers to the daffodils of spring, which run so much to yellows. Many bulbs may be dried off with impunity, and indeed many which are natives of countries with dry summers, such as Africa and Asia Minor, may be given dry warm storage with advantage; but lilies of all kinds are never dormant long and the bulbs should never be allowed to dry out. They must be kept moist while out of the ground and planted so soon as possible. Hyacinths, tulips, and many others which enjoy warm storage in a dry state should be held until about the month of April before planting.

Evergreen hedges trimmed now will quickly regain a good appearance and keep it for a long period.

—*W. C. Hyde, Horticulturist, Wellington.*

SALE OF PASTEURIZED CREAM BY DAIRY COMPANIES.

By an amendment to the regulations under the Dairy Industry Act, 1908, governing the sale of milk or cream for human consumption, which amendment came into force on the 12th December, dairy companies are authorized to sell cream for human consumption subject, however, to the following special conditions :—

(1) The cream must be either cream to which has been assigned the grade of "Finest" or cream taken from milk to which that grade has been assigned in terms of the Dairy-produce General Regulations, 1933

(2) The cream must be pasteurized in conformity with the regulations under the Sale of Food and Drugs Act, 1908 - that is to say, it must be cream which has been retained at a temperature of not less than 145° F., and not more than 150° F., for at least thirty minutes and immediately cooled to a temperature of not more than 55° F., and protected from recontamination The cream must not be so heated more than once and must not be otherwise treated by heat It must not contain any living coliform bacillus in one-tenth of a centimetre

(3) The cream must be labelled in conformity with the regulations under the Sale of Food and Drugs Act

(4) Every sale of pasteurized cream must be subject in all respects to the provisions of the Sale of Food and Drugs Act the Health Act, 1920, and all regulations thereunder for the time being in force

(5) The provisions of the Dairy-produce General Regulations requiring registration of premises as a manufacturing dairy must be complied with.

—*A. E. Morrison.*

The Fields Superintendent, Christchurch, reports that in the 1934 season an Annat farmer purchased 4 tons of certified Aucklander Short Top seed potatoes at £8 per ton and 2 tons of uncertified seed of same variety at £2 per ton He planted them in the same field and the potatoes had the same treatment The season was a dry one. The certified potatoes yielded 9 tons per acre and the uncertified 4 tons per acre. The certified potatoes returned the grower £36 per acre, and the uncertified £11 per acre.

Government Pedigree Stock Seed - The Department of Agriculture will have available for sale following the harvesting of the 1935-36 grass and clover seed crops a limited quantity of Government pedigree stock seed of perennial rye-grass, white clover, and Montgomery red clover. This seed has been grown on contract for the Department from seed specially raised at the Plant Research Station, Palmerston North, and is available for purchase for the sowing-down of areas intended for the production of certified pedigree seed All purchases of Government pedigree stock seed must be made through recognized merchants, and orders will not be filled unless they are received through merchants. Further particulars may be obtained from any officer of the Fields Division of the Department throughout the Dominion.

REVIEW.

Toadstools and Mushrooms and other Larger Fungi of South Australia: Part II. By John Burton Cleland, M.D. Royal octavo, 184 pp., 4 coloured plates, 41 text figures. Government Printer, Adelaide.

The work under review forms Part II of one of a series of handbooks on the fauna and flora of South Australia, issued by the South Australian Branch of the British Science Guild. It covers fungi belonging to the Polyporaceæ, Hydnaceæ, Clavariaceæ, Gasteromycetes, Heterobasidiæ, Larger Ascomycetes, and Myxomycetes known to occur in South Australia. Together with Part I, it is a noteworthy contribution to the scientific literature of South Australia, since it is the only accurate work published containing detailed descriptions of the fungi of this region. No less than 249 species are described, of which 116 are endemic to Australasia. Descriptions are carefully drawn, for the most part from collections made by the author, and, where more than one species occurs in a genus, are preceded by carefully arranged diagnostic keys. The work concludes with an index to species, genera, &c., described in Parts I and II, so that both may be bound into a convenient single volume.

The extremely reasonable price of 5s. is charged for each part, a price which places the work within the reach of all students of these interesting plants.

G. H. C.

NEW-ZEALAND-GROWN FRUIT (LOCAL SALES) REGULATIONS, 1935.

The purpose of the New-Zealand-grown Fruit (Local Sales) Regulations, 1935, which came into force on the 19th December, is to consolidate the regulations hitherto in force governing the sale within the Dominion of New-Zealand-grown fruit of the kinds set out therein, and at the same time to provide standards for the grading of lemons. In addition, the opportunity has been taken to recast the standards for the grading of apples and pears to conform with the grading-standards laid down under the Government guarantee conditions with respect to export fruit.

The grading-standards for lemons are set out in detail in Regulation 8. The grading of lemons will not be compulsory except in the case of lemons sold in packages bearing the word "cured." The word "cured" or the words "not cured," as the case may require, must, however, be branded on all packages containing lemons for sale.

The increasing role of pig-keeping in our farming makes it particularly advisable that pig-keepers realize and apply in their practice the fact that there is a close correlation between general management and the incidence of diseases and disorders. Large numbers of pigs are rejected for export, and many of the rejections may be attributed to faulty management Apart altogether from these rejections, which are serious in themselves, it has to be borne in mind that economic production of the pig-meat that is passed for export is intimately linked with good management, particularly in respect to feeding and accommodation.

—*Annual Report, Director-General, Department of Agriculture.*

For the second year in succession the sales of lucerne cultures by the Department have been sufficient to treat the seed required for the sowing of approximately 6,000 acres. The annual sowings of lucerne do not represent a net increase in the Dominion effective acreage: they are offset by the portion of previously established lucerne which each year goes out of production on account of its age, &c.; but the official statistics show that when allowance is made for this there is a steady increase in the Dominion acreage of lucerne. While this increase is not as great as the merits of lucerne would justify, it is probable it will be greater in the immediate future.

—*Annual Report, Director-General, Department of Agriculture.*

WEATHER RECORDS: DECEMBER, 1935.

Dominion Meteorological Office.

NOTES FOR DECEMBER.

DECEMBER was a remarkably fine month. For the holiday-makers there was abundance of fine and warm weather, yet at the same time the man on the land, generally speaking, got just the conditions he desired. Temperatures were much above normal, and though the last few days were relatively cool there was no really cold spell. Rainfall was, in general, considerably below normal, but this was no drawback after the wet and cold spring. One or two good falls met all requirements in most districts. A fairly humid atmosphere and an absence of wind were favourable features which tended to minimize any lack of rain. Stock are reported to be in good condition and lambs fattening well. There is abundance of feed, and much hay and silage were made under favourable circumstances. Crops promise to be much above average. Conditions were favourable for shearing, but it is still somewhat behindhand.

Rainfall.—Rainfall was generally above average north of Kawhia and Tauranga and in parts of Taranaki, but elsewhere, except for isolated patches, it was very much below. Canterbury had only about 25 per cent. of the average.

Temperatures.—From Nelson and Marlborough northwards temperatures were generally from 2 to 4 degrees above average To the southward the departures were still greater, rising to over 6 degrees in South Canterbury and Otago and to 7 degrees at Invercargill. In these latter parts it was the hottest December on record, with the exception of that of 1934. Christmas was, in many places, the warmest recorded, and there were other very hot days.

Sunshine.—Nelson, Marlborough, and Canterbury had more than the average sunshine, but elsewhere conditions were fairly normal

Pressure Systems.—The month was remarkable for the persistence of high pressure over the Dominion. Anticyclonic conditions prevailed continuously until the 12th, fine and warm weather being almost general throughout this period. There were slight disturbances on the 13th and 14th, which caused scattered light to moderate rains and a few thunderstorms, but mainly in western districts and from Taranaki southwards.

The only vigorous depression affecting the country during the month was one which arose from the remains of a tropical cyclone which developed in the New Hebrides on the 14th. This depression passed down the west coast of the North Island and thence across the South Island during the period from the 17th to the 19th. It caused general rains, which were of very great benefit. Except eastern portions of the South Island almost all districts had heavy falls, and in North Auckland there was some flooding. Inland from Oamaru, also, there were some isolated very heavy rains. A north-easterly gale did some damage in Auckland Harbour on the 18th.

After another period of anticyclonic weather a moderate depression passed rather rapidly eastward between the 28th and 30th Widespread rains again occurred, with heavy falls in many places, but the rain was not so general nor so long continued as in the previous depression. Rather cool weather followed till the end of the month.

RAINFALL FOR DECEMBER AND CALENDAR YEAR 1935 AT REPRESENTATIVE STATIONS.

—	December, 1935.				Calendar Year.	
	Total Fall.	Number of Wet Days.	Maximum Fall.	Average December Rainfall.	Total Rainfall.	Average Rainfall.
			North Island.			
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	4·30	5	2·33	2·63	70·48	54·31
Russell	12·49	6	7·70	2·55	100·59	49·94
Whangarei	4·19	7	1·50	2·99	80·54	60·51
Auckland	3·36	7	1·13	3·18	61·50	49·35
Hamilton	1·94	8	0·55	3·50	48·16	49·54
Rotorua	3·36	8	0·88	3·65	69·70	54·98
Kawhia	2·60	6	0·80	3·30	..	53·72
New Plymouth ..	4·98	7	1·43	4·21	77·27	59·70
Riversdale, Inglewood ..	5·35	7	1·63	7·48	115·88	104·17
Whangamomona ..	3·24	6	1·31	5·63	85·59	77·55
Hawera	3·27	6	1·23	3·25	58·03	45·21
Tairua	5·34	4	2·65	4·37	75·06	64·44
Tauranga	3·84	10	1·41	3·47	64·40	52·28
Maraehako Station, Opotiki	1·29	6	0·70	2·92	70·50	53·37
Gisborne	1·19	5	0·68	2·30	46·80	45·13
Taupo	1·95	8	0·70	3·12	53·67	43·87
Napier	1·62	8	0·71	1·94	51·38	30·08
Hastings	0·66	8	0·22	1·88	39·42	31·86
Whakarara Station ..	4·84	10	2·04	..	66·71	..
Taihape	0·65	9	0·19	3·26	37·17	36·72
Masterton	1·89	6	0·94	2·77	45·93	38·24
Patea	3·34	9	1·08	3·52	58·71	44·81
Wanganui	2·52	6	0·90	2·69	43·97	36·11
Foxton	1·75	6	0·87	2·64	36·08	32·51
Wellington	3·09	8	1·65	2·93	40·74	42·30
			South Island.			
Westport	3·44	8	1·48	8·45	88·25	96·80
Greymouth	4·26	16	1·02	8·65	91·36	101·55
Hokitika	4·16	11	1·17	10·37	105·00	114·94
Ross	5·21	8	2·00	12·05	111·65	135·49
Arthur's Pass ..	5·02	6	2·10	14·11	121·70	161·91
Okuru, South Westland	10·09	8	3·45	10·97	103·49	144·47
Collingwood	5·57	5	3·78	7·97	103·03	97·40
Nelson	3·60	5	2·30	2·96	47·96	37·82
Spring Creek, Blenheim	1·25	5	0·50	2·10	28·55	30·28
Seddon	0·87	6	0·52	1·96	23·00	24·80
Hanmer Springs ..	3·17	4	1·76	3·80	45·32	45·09
Highfield, Waiau ..	3·00	4	1·59	2·64	34·69	33·28
Gore Bay	1·65	5	1·01	2·57	28·58	31·27
Christchurch	0·52	4	0·36	2·46	22·07	25·13
Timaru	0·60	4	0·35	2·42	19·89	22·68
Lambrook Station, Fairlie	1·57	5	1·07	2·57	22·38	24·87
Benmore Station, Clearburn	1·24	6	0·53	2·34	22·79	24·64
Oamaru	1·17	8	0·27	2·25	19·09	22·01
Queenstown	1·33	3	0·96	2·51	28·86	30·50
Clyde	0·86	3	0·68	1·76	14·49	15·22
Dunedin	1·54	10	0·55	3·47	35·23	36·65
Wendon	1·67	9	0·73	2·82	31·36	29·96
Balclutha	1·01	5	0·43	2·56	29·65	25·62
Invercargill	1·51	14	0·32	4·00	43·77	45·65
Puysegur Point ..	6·08	14	1·27	7·17	83·16	85·26
Half-moon Bay ..	2·11	14	0·53	4·90	55·78	58·79

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FARMING IN THE AUCKLAND PROVINCE.

OBSERVATIONS ON FARM-MANAGEMENT METHODS.

P. W. SMALLFIELD, Fields Superintendent, Auckland.

III. THE MIDDLE WAIKATO BASIN.

HOCHSTETTER(9) travelled up the Waikato River in 1858, and, on reaching Taupiri, climbed to the top of the Taupiri Mountain, and, looking over the Middle Waikato Basin, described the area as follows :—

Here I beheld for the first time an extensive lowland spreading into distant mountain cones and remote mountain chains . Like mirrors resplendent with the broken rays of the sun, you see glistening numerous lakes, and the serpentine currents of large rivers winding through the plains The Waikato is the main river in this richly watered, fertile basin, which in its extent from the western to the eastern mountain ranges I call the Middle Waikato Basin. The Waikato flows through this basin in the direction of south-east to north-west, a distance of thirty-five miles Immediately at the foot of the Taupiri the Mangawara joins it, running through large swamps in the east, and five miles further up it receives the Waipa, a principal tributary from the south-west Up the Waipa towards the south-west and south, along the western coastal range, the lowland extends as far as the slopes of the picturesque trachytic mountain Pirongia, and the spurs of the Rangitoto Range, where from the midst of the plain Kakepuku rises with regular conical slope To the south and south-west, where the Waikato enters from the southern tableland into the basin, there rises majestically the trachytic Maungatautari. Thence springs up a low range of hills, the Maungakawa range, separating the eastern portion of the basin—the plains of the Piako and Waihou, rivers of considerable size emptying into the Hauraki Gulf—from the Waikato and Waipa Plains. But it is only the steep margin of the eastern coast range, from the Patetere Plateau to the Aroha Mountain, that forms the eastern boundary of the basin. This whole basin was, previous to the last elevation of the North Island, which was probably connected with the volcanic eruptions in the centre of the Island, a bay of the sea, extending from the Hauraki Gulf far into the interior. The steep margin of the surrounding ranges has continued to this day, displaying the seashore of old, and the singular terrace formations on the declivities of the hills and river-banks within this basin is the result of slow and periodical upheaving.

THE WAIKATO AND WAIPA PLAINS.

The plains of the Waikato and Waipa Rivers consist of low rolling hills, flat areas of alluvial land, and large peat swamps. The soils of the low rolling hills are loams and clay loams (derived from volcanic ash-showers) of fair natural fertility, and it was on these low rolling hills that settlement first took place. The soils of the wide plains of the Waikato are sands and loams derived from pumice sand deposited by the Waikato River. The peat areas are generally of low natural fertility, and are still largely unoccupied.

Church of England missionaries introduced farming to the Waikato Natives about 1840. The Rev. John Morgan (Te Awamutu) introduced English methods of farming, brought in English fruit-trees, taught the Natives to grow wheat and to grind it in their own water mills. The period from about 1845 to 1860 was an era of peaceful progress and industry amongst the Waikato Tribes. The farming missionary succeeded in giving the district round Te Awamutu a thoroughly settled and Home-like appearance. The wheat grown by the Natives in the Rangiaowhia - Te Awamutu district was ground at the mills, bagged, and sent down to the European settlements for sale. The flour was carted in bullock-drays to Te Rore, where it was loaded into canoes. The canoes were paddled down the Waipa and Waikato Rivers along the Awaroa to Waiuku and there loaded into cutters and transported to Onehunga. It was finally taken across the isthmus to Auckland—a total journey of over a hundred miles from the flour-mills of Rangiaowhia. The Maoris invested the proceeds in clothes, blankets, tea, sugar, and all kinds of European goods, and then began their homeward journey(10).

A variety of elements, social and political, combined to produce a war feeling in the Waikato. The Waikato Tribes had always been averse to selling their land to Europeans, and aspired to form a separate Maori State in the centre of the North Island. The Waikato War was precipitated by trouble arising out of disputed land-purchases in Taranaki. In 1864 there was severe fighting in the Waikato, and the Maoris were finally defeated at the Battle of Orakau. The Government confiscated the land of the rebellious Natives under the New Zealand Settlement Act of 1863 and settled the country with disbanded militiamen and civilians—about 3,000 military settlers, each of whom received a grant of one town acre and a farm section of from 50 acres upwards, according to rank.

The new settlers adopted mixed-farming methods—wheat and potatoes were the marketable crops. cattle and sheep were fattened, and butter was made on the farms and traded to local storekeepers. The depression in the "eighties" was severely felt in the Waikato, and it was not until the late "nineties," when the dairy industry was becoming established, that farmers were at all prosperous. Small cheese-factories had been started in the early "eighties," but, owing to poor road communication, the factories could not draw sufficient regular supplies of milk, and had to go out of business. The dairy industry was successfully launched in the "nineties" by the inauguration of a system of skimming-stations or creameries to which the farmers brought their whole milk, and the cream separated at these skimming-stations was manufactured into butter at a central factory. With the development of an export trade, further changes were introduced—establishment of co-operative factories, the practice of home separation, and improved road transport. Dairying, which had developed as a sideline to mixed farming, became a separate enterprise. Permanent grassland took the place of short-rotation pastures, and the practice of intensive grassland farming was slowly evolved. To-day grass-farming in the Waikato has reached a very high standard of efficiency.

The Waikato enjoys a warm humid climate; the annual rainfall is about 50 in., and is well distributed. Farming is grass-farming—dairying and the production of lamb, mutton, wool, and beef from

permanent grass. It was in the Waikato that the practice of top-dressing started. Prior to the advent of top-dressing, pastures soon deteriorated, and after being down from four to five years they were ploughed up, the land cropped with cereals and fodder crops, and then

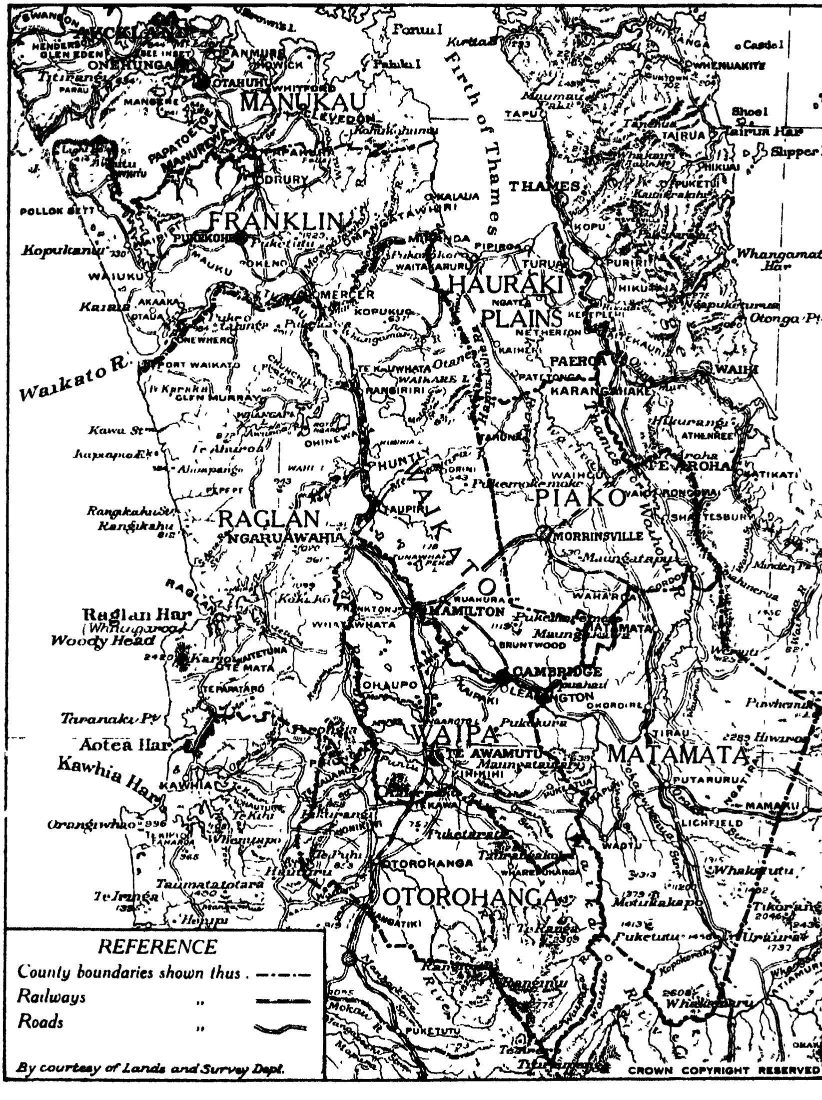

FIG 4. SOUTH AUCKLAND, LOWER AND MIDDLE WAIKATO BASINS.
Journey in southern Waikato, Waipa, and Otorohanga Counties.

sown down to grass again. The first attempts at pasture improvement by top-dressing were probably made in the early "eighties" on old grassland near Cambridge. By 1900 top-dressing with phosphatic

fertilizers was becoming a recognized practice, and at the present time most of the grassland is top-dressed annually.

*Table III.—Crops and Live-stock : Table showing Areas in Crops and Pasture and Numbers of Live-stock in Waikato Counties, 1933–34.**

County.	Crops.			Live-stock.			
	Annual Crops.	Pasture.	Pasture cut for Hay and Silage.	Dairy Cows.	Other Cattle.	Sheep shorn.	Pigs.
	Acres.	Acres.	Acres.				
Waikato† ..	5,293	203,712	22,716	73,020	43,856	94,666	27,901
Waipa ..	4,036	176,015	25,085	72,329	41,715	96,489	28,370
Otorohanga† ..	4,581	122,339	11,745	34,635	25,381	62,602	15,147
	13,910	502,066	59,546	179,984	110,952	253,757	71,418

* From Agricultural and Pastoral Statistics. † Only parts of Waikato and Otorohanga Counties are on the Waikato and Waipa Plains.

Dairying and fat-lamb raising are the chief farming industries. Swedes and soft turnips are grown and hay and silage saved for the winter and summer supplementary feeding of dairy stock. Where the soil is suitable, lucerne is becoming a crop of some importance, and Waipa County has 1,015 acres of lucerne. Grass-farming has reached a high standard of efficiency—the production of 150 to 200 lb of butter-fat per acre and a carrying-capacity of four ewes to the acre are not uncommon. Romney ewes for fat-lamb raising and store cattle for fattening are drawn from a wide area—from the East Coast, King-country, and Wellington Districts; four- and five-year-old Romney ewes are mated with Southdown rams, and usually 90 per cent. of the lambs are got away fat off their mothers.

January 21st, 1935 : Motumaoho, Tauhei, Orini, Newstead, Hamilton.—An intensely hot day, pastures all burnt up after a long period of dry weather, and the air thick with the smoke of peat fires. Here and there are green patches in the pastures, which indicate areas of paspalum. Even this plant is feeling the effect of the exceptionally dry weather, and is throwing much less feed than it does in normal years. Lucerne also shows a poor growth, and there is no doubt that the only real insurance for the dairy-farmer against prolonged drought is an adequate reserve of grass silage.

Paspalum could be used more extensively in Waikato pastures; where control is good in the summer there is no difficulty at all in maintaining a sward of rye-grass, white clover, and paspalum—a pasture which has probably the highest carrying-capacity that is possible on this class of land. Paspalum is usually slow in establishing, and, with the common method of sowing from 3 lb. to 5 lb. of paspalum-seed in an ordinary rye-grass, cocksfoot, clover mixture, it is several years before much paspalum is seen. Paspalum needs really warm conditions for quick germination, and a practice has begun of establishing paspalum alone or with a cover crop (such as soft turnips or Japanese millet) in late November or December. Sown alone at the rate of 10 lb. per acre in December, paspalum establishes very rapidly. I recently saw a 5 acre field which was sown this way last December and which is now almost completely covered with paspalum plants. For sowing in this

way the land should be worked up to a good clean seed-bed as for ordinary grass-sowing, rolled, and from 8 lb. to 10 lb. of paspalum-seed sown along with 1 cwt. of superphosphate. In the autumn the field should be harrowed and rye-grass and white clover broadcasted. Only a light surface cultivation is required to secure a seed-bed for the autumn-sown rye-grass and white clover. Any one who wishes to secure a dominant paspalum pasture quickly is advised to try this method of establishment.

[*Photo by H. Drake.*

FIG. 5. RUAKURA FARM OF INSTRUCTION, WAIKATO COUNTY

The Ruakura Farm Training College offers a course in farm-training to lads of not less than sixteen years of age ; the course for the full curriculum occupies eighteen months, but the ordinary course is completed in one year Instruction is imparted by lectures and by field classes and demonstrations The year is divided into two terms of twenty-four weeks The fee for each term for tuition and board is £18. Application for admission should be made to the Director of the Fields Division, Department of Agriculture, Wellington

There are in evidence numerous crops of Japanese millet which are doing well in spite of the dry weather. Japanese millet is a crop that does well in a hot season, and has been well worth while sowing in a year like this. Eight or ten years ago crops of Japanese millet used to be quite common, but they went out as the practice of making grass silage became common.

Peat fires were burning strongly in the Motumaoho, Orini, and Newstead districts. These Waikato peat lands are a great problem—originally great swamps covered in rushes and stagnant water, the areas have now been drained or partially drained, with the resulting change in natural vegetation from rushes and moss to manuka and bracken fern. Undrained peat is extremely wet, whilst overdrained peat is extremely dry—once thoroughly dried it does not readily rewet, but forms a light porous mass that is nearly always fluffy and dry ; in fact,

water may lie in puddles on peat land from the bottom of which perfectly dry peat can be scooped up. The essentials in grassing peat land are gradual drainage and consolidation. The initial grassing of raw peat swamps is done with Yorkshire fog and *Lotus major*—two plants that are admirably suited for pioneer grassing-work on raw and unconsolidated peat: paspalum, also, could be made more use of than it is. It is only where really careful drainage, consolidation, and management have been practised that reasonable pastures with a fair proportion of rye-grass and white clover in them can be established. When overdrained, the surface dries out badly in the summer and the main pasture constituents are Yorkshire fog and brown-top.

It will probably be next season before the peat areas which are at present burning can be regrassed, for the peat fires are not likely to go out until the water in the swamps reaches its winter level. These uncontrollable summer fires do a great deal of harm—the peat being dry to a considerable depth the fires burn deeply, leaving an uneven surface with often great holes. Surface burning is a great help in getting a good strike of grass and clovers, but it must be controlled burning; generally, if the peat is sufficiently consolidated, the area is ploughed, the furrow slices allowed to dry out, and burnt whilst the bottom is still wet. This type of burning gives a thin ash layer in which to sow grass and clover seed. There is still a good deal of difference of opinion whether peat should be burnt or not; certainly burning gives the best seed-bed and the best establishment of grass and clover. Arthur Young's remarks on the subject are of interest: in his Farmer's Calendar, he writes:—

> By one set it (paring and burning) is pronounced contrary to every principle, that it is a wasteful, extravagant operation, which dissipates what should be retained; annihilates oils and mucilage; calcines salts, and reduces fertile organic matter into ashes of a very weak efficacy: that the vegetable particles which are brought into play at once, for the production of a single crop, by less desperate management might be husbanded to the support of many On the contrary, the advocates for this management assert that these objections are all founded on vain reasoning and philosophical theory: that the practice the most decided and experience the most extended pronounce it to be an admirable system and that the mischiefs often quoted as flowing from it are to be attributed merely to the abuse of the method, and by no means necessarily connected with it . In the fens of Cambridgeshire upon a peat soil, free from large roots and stones, the work of paring is always done with a plough, which they make on purpose for the work, and which executes it in the completest manner that can be imagined. It turns off a furrow from 12 in. to 16 in broad and not more than an inch deep

Local burning, when done, is generally deeper than this; in the first burning of a swamp with a fire just running over the surface it may only burn a couple of inches, but if ploughed (and a swamp plough is sometimes used) six inches to a foot of peat may be burnt off as a preparation for grass.

January 24th, 1935: Ruakura Farm of Instruction.—The Ruakura Farm of Instruction is a farm training college for youths, a stud-stock farm, and a centre for experimental work. The farm has an area of 900 acres, and the general level of the land is broken in parts by low undulations; the soils of the low hills are clay loams, of the flats silts and sandy loams, formed from water-borne pumice, and peat; the peat areas occupy a considerable area of the farm and are of quite low fertility. In common with other Waikato farms, the bulk of the land is under permanent grass, and dairying, fat-lamb raising, and the production of stud stock are the chief farming industries. The farm maintains

pedigree herds of Jerseys, Ayrshires, Milking Shorthorns, and Guernseys: about 150 cows are milked in two sheds. The annual draft of pedigree bulls is disposed of as yearlings and heifers as two-year-olds. There is a registered flock of 200 Southdown sheep, together with 1,500 to 2,000 cross-bred ewes, from which fat lambs are raised. Pedigree herds of Berkshire, Large White, and Tamworth pigs are kept, and I was present at the weighing of various lots of fattening pigs. Recently the outdoor grazing of pigs has received considerable attention from Waikato farmers, but there is a great deal yet to be learnt regarding the value of grass for fattening pigs. Young grass can form a very important part of the ration of dry sows and store pigs, but its exact value for fattening pigs, receiving a diet of skim-milk, requires further investigation. The accepted feed-position in pig-fattening is that 400 lb. of grain or 400 gallons of milk are required to give 100 lb. live-weight gain: a pound of grain and a gallon of milk are of about equal feeding-value: green feed may at times replace concentrates to a limited extent—6 lb. to 8 lb. of green feed are equal to 1 lb. of grain but green feed can replace only 1 lb. or 2 lb. of concentrates in the fattening pig's ration. The problem is to find just what use, if any, green feed is for fattening pigs getting a skim-milk ration, and, if it is useful, the best method of supplying it. Small ⅛ acre fields require very careful management if a good sward of grass is to be kept on them; with tramping, and excessive grazing and manuring, the white clover goes out, rye-grass becomes tufted, and the fields are apt to run to bare ground: the grazing and management adopted in ordinary dairying pastures gives the ideal sward for pig-grazing, but it is possible that if pigs are grazed in large fields they may "walk off" too much condition, and, for finishing, sty-feeding is quite likely to come back.

April 15th, 1935: Hamilton, Matangi, Cambridge.—The Hamilton-Cambridge district is an area of quite intensively managed grassland, the farms are well planted with hedges, plantations, and ornamental trees, which give a very finished appearance to the countryside. Stopped at a Matangi farm and examined an autumn-sown field of Italian rye-grass, sown to provide young grass for early-calving cows. The provision of protein-rich feed for the spring feeding of milking herds still remains somewhat of a problem on the general run of dairy-farms—feed can be supplied by green cereals, temporary pastures of Italian rye, and by nitrogenous manuring of perennial rye-grass pastures, all of which entail expense. The usual method is to shut up phosphated fields in May and June and hold the grass-growth for cows calving in July; this method is fairly satisfactory provided the fields are well sheltered, but there is often a gap in feeding between mid-August and mid-September—between when the shut-up grass has all been used and when spring growth starts. When this happens herds have to draw on bodily reserves—herds calving in good condition may maintain production at the expense of condition, but with herds calving in poor condition a fall in milk-production is inevitable. A good vigorous strain of Italian rye sown in March produces good autumn, winter, and early-spring feed, and where the farmer can find the time and money for sowing special crops, Italian rye pastures are excellent for spring feeding.

WAIPA COUNTY.

April 17th, 1935: Hamilton, Te Rapa, Te Kowhai, Koromatua, Ngahinepouri, Ohaupo, Rukuhia.—A fine autumn day; this is a fairly

slack time on farms, top-dressing is just being completed and feeding out has not started. Feed is fairly short and there has been a fair amount of pasture deterioration on the lighter soils owing to the excessively dry summer weather. Under very hot, dry conditions, white clover dies out and leaves bare ground: this is a very unusual occurrence in the Waikato, but commonly occurs on shingly and sandy soils with a poor capacity for holding water in the summer. In dry climates, or on summer-dry soils in humid climates, subterranean clover often has to be used instead of white clover for grassing dry soils. Subterranean clover is an annual and buries its seed in the ground; the seed germinates in February–March, the young plants have a good autumn, winter, and early-spring growth; growth is luxuriant and very rapid in October and November, whilst the plants start to wither and die about the middle of December. Under the humid conditions and good moisture-holding capacity of Waikato soils, white clover will always be the chief pasture clover of the district, but on summer-dry soils subterranean clover finds a place: it is fairly common on the basic volcanic soils of North and South Auckland.

Waipa County occupies the roughly triangular land area between the Waipa River on the west, the Waikato River on the north and east, and the Puniu River on the south: the south-east corner is on volcanic land surrounding Mount Maungatautari. The land of the county consists of low rolling hills, flat areas of alluvial land—being the flood-plains of the Waikato and Waipa Rivers,—and large peat swamps. The low hills consist of the dissected flood-plain of an old river, and these hills have been covered by volcanic ash-showers; in the north the soils are clay loams—soils that grow good cereals and root crops and good pastures too, but are apt to dry out in the summer; in the south these hills have been covered in more recent ash-showers, the soils are lighter, and have a good summer moisture-holding capacity. The alluvial soils consist of sands—on the banks of the Waikato—sandy loams, silts, and clays. With the exception of the peats, variation in fertility is mainly a matter of moisture-holding capacity: all soils (except poor peat areas) grow good rye-grass, cocksfoot, white-clover pastures if suitably top-dressed and managed.

The progressive improvement during the past thirty years in the carrying-capacity of the grassland has been truly remarkable, and for the 1933–34 season the carrying-capacity was roughly two and a half times as great as in 1906–7. The details of the acreage under pasture, fodder crops, and the number of live-stock for these seasons are given in Table IV.

*Table IV.—Table showing Areas in Sown Grass, Fodder Crops, and Numbers of Live-stock in Waipa County for the Seasons 1906–7, 1926–27, and 1933–34.**

Season.	Crops.		Live-stock.		
	Pasture.	Fodder Crops.	Dairy Cows.	Other Cattle.	Sheep shorn.
	Acres.	Acres.			
1906–7 .. .	87,330	9,778	10,321	283,91	223,86
1926–27	165,342	7,672	44,388	338,28	489,12
1933–34	176,015	4,952†	72,329	417,15	964,89

* From Agricultural and Pastoral Statistics. † Includes 1,015 acres of lucerne.

Dairying and fat-lamb raising are the main farming industries, and for the 1926–27 season, when surveys(11) of the farms of the county were made, there were 1,483 holdings (in 1933–34 there were 1,533 holdings), divided as follows:—

Enterprises.	Number of Holdings.
Dairy-farms over 30 acres	863
Fat-lamb farms	58
Dairying and fat lambs	48
Cattle farms	59
Miscellaneous (mainly holdings of less than 30 acres)	455
	1,483

The 863 dairy-farms covered a total occupied area of 164,662 acres, of which 114,146 acres were in pasture and 5,954 acres in annual crops. Classified on the cultivated area, there were 358 farms between 30 acres and 99 acres in area, 345 farms 100 acres to 199 acres in area, and 160 farms over 200 acres. The most important size-groups were farms of 50 acres to 59 acres, 100 acres to 109 acres, 150 acres to 159 acres, 200 acres to 209 acres, and farms over 300 acres. The following table shows the mean area under grass and annual crops, the mean area of grassland top-dressed and hayed, and the mean number of cows milked per 100 acres of cultivated land for groups of dairy-farms for the 1926–27 season(12).

Table V

Size of Farms.	Number of Farms.	Area in Grass	Area in Crops	Area hayed	Area top-dressed.	Number of Milking Cows, 31st January, 1927
50– 59 ..	89	95	5	16	78	43
100 109 ..	108	95	5	13	70	37
120–129 ..	34	95	5	13	73	35
150–159 ..	41	94½	5½	12	65	35
200 209 ..	29	95½	4½	12	79	35

The carrying-capacity of these farms in 1926–27 was not particularly high, but there has been a farming revolution since then: from 1928 onwards greater attention has been paid to pasture-management, ensilage has come in, and with more stock there has been more manure, and hence more grass to carry still more stock. This is well shown in Table IV, comparing the 1926–27 carrying-capacity with the 1933–34 carrying-capacity. The area under pasture and crops has increased by 5 per cent., the dairy cows by 63 per cent., other cattle by 23 per cent , and sheep shorn by 97 per cent.

In the 1926–27 survey(13) there were 58 holdings devoted to fat-lamb raising, occupying a total area of 27,941 acres, of which 18,969 acres were in grass and 1,150 acres in annual crops. The average (mode) size of holding classified on the improved area was between 300 acres and 400 acres, and the mean carrying-capacity was about 2 ewes to the acre (it will now be about 4 ewes),

although the better farms were carrying 3 to 3½ ewes. There were 48 holdings devoted to dairying and fat-lamb raising combined: the farms occupied a total area of 20,640 acres, of which 17,596 acres were in sown grass and 842 acres in fodder crops. The average (mode) size of farm classified on cultivated area was between 200 acres and 300 acres. The 58 holdings devoted to cattle-grazing were devoted to raising dairy heifers and fattening beef cattle.

In passing, it is interesting to notice the co-ordination in farm enterprises devoted to animal husbandry. The fat-lamb and cattle-fattening farms are co-ordinate with the extensive grazing-runs on surface-sown hill country—they utilize the old ewes from the grazing-runs for raising fat lambs and fatten the surplus sheep and cattle. The extensive grazier in turn depends on the intensive grazier for bulls and rams. The need for intensive grass-farms for fattening the surplus sheep and cattle from the surface-sown grazing country is now more important than it was in the past. When the forest land was being converted into pasture, the grazier sowed turnips and rape along with the grass-seed in his annual burns, and obtained bulky crops for stock-fattening. At present this is not possible, and there has been on most runs a gradual pasture-deterioration The movement of stock from one area to another allows of specialization of enterprise. The extensive grazier regulates his stocking to the feed produced by his pastures, and fattening is carried out on farms where crops and good pastures can be cheaply produced. Specialization of enterprise is responsible for the existence of a long line of middlemen—transporters and dealers—between the enterprises producing store animals and the enterprises devoted to fattening.

OTOROHANGA COUNTY.

January 23rd, 1935: Kihikihi to Wharepuhunga.—The middle portion of Otorohanga County is on the plains of the Waipa—to the west it runs over the foothills of the Western Upland and in the south-east to the Central Plateau and the spurs of the Rangitoto Range. On the plains of the Waipa, farming-conditions are very similar to southern Waipa County—gently rolling hills and plains with dairy and fat-lamb farms. The farming of the higher country has not been quite as successful: ragwort is troublesome; much of the original grassing was done with false perennial rye-grass; areas have deteriorated; fern and ragwort have come in.

A very hot day after a long spell of dry weather and pastures burnt up. Visited a large farm where the original grassing had not been good, top-dressing somewhat neglected, and carrying-capacity declining. This year owing to the drought and the poor state of the pastures only 50 per cent. of the lambs were got away fat, and this has occurred in other places, and once pastures start to go back a drought hits them very badly. The farm consists of great grassed fields, rising here gently, there abruptly, from the stream valleys, with in places great cliffs and pinnacles of rhyolite. Originally fern and tutu land, the procedure in grassing had been to first burn and surface-sow, with or without surface cultivation, a temporary pasture of Italian rye-grass, cocksfoot, red and white clover:

red clover was the principal plant, and, with its strong summer growth, is excellent for crowding out fern and allowing of heavy summer stocking with cattle for fern-crushing.

At first sight bracken fern would appear to be impossible to eradicate, the fronds are unpalatable, the plants have great root development and grow with great rapidity. Yet with all its obvious advantages for holding possession of the ground it possesses four fatal defects that make its control possible. These are the incapacity of the underground stems to develop fronds except in specially defined places ; the inability of the frond to grow when once broken off ; the extreme ease with which the frond may be broken before it expands, or when it is in what is known as the curl stage ; and the long dormant season extending from the autumn to the late spring(14). To control the fern and establish grass, the temporary pasture of Italian rye-grass and red clover is excellent ; it allows of heavy spring and summer stocking, so that the young fern-fronds may be broken off in the curl stage and the fern crushed out.

On the deterioration of the temporary pasture and the disappearance of most of the fern the land was ploughed, sown in swedes, and then in permanent grass following swedes. Much of the permanent grassing was done before supplies of good certified perennial rye-grass seed were available—pastures are now poor, and ragwort has come in. The essentials in grassing this light country are good cultivation, the use of certified strains of rye-grass and white clover, and adequate top-dressing with phosphates. Good cultivation is important : the land should be ploughed with a lea mouldboard plough, rolled on the furrow, double-disked to a fine seed-bed, chain-harrowed to level the surface, and rolled before and after sowing seed and fertilizer. Rolling on the furrow with the Cambridge roller is most important : this rolling consolidates the bottom of the seed-bed and brings the soil moved by the plough again in contact with the unmoved subsoil, making a continuous firm layer of soil through which soil-moisture may move from the deeper layers to the surface. The usual grass-mixture consists of 20 lb. to 25 lb. certified perennial rye-grass, 8 lb. to 10 lb. cocksfoot, 2 lb. to 3 lb. crested dogstail, 2 lb. red clover, and 2 lb. white clover : the seed should be sown with 3 cwt. superphosphate, and thereafter top-dressed annually with 2 cwt. to 3 cwt.

Ragwort in much of the back country is a serious problem. On small intensively managed dairy-farms it can be kept under control by spraying and dusting with sodium chlorate. On larger farms sheep are necessary to help with control , but on farms where pastures have greatly deteriorated and ragwort covers most of the ground, ploughing followed by resowing appears to be the only feasible method of management.

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THE WINTER FEEDING OF STOCK IN CANTERBURY.*

FACTORS IN DAIRY-COW PRODUCTION.

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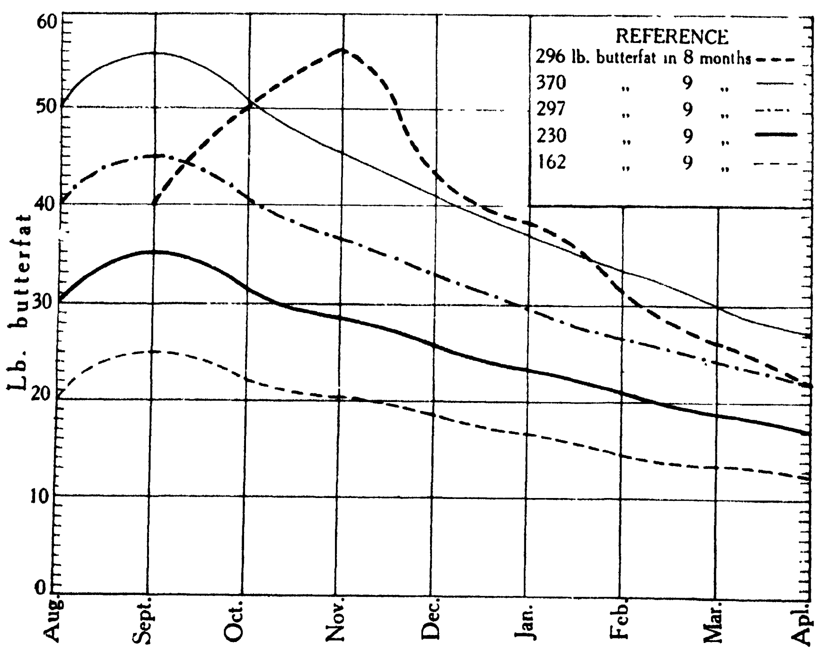
THE winter feeding of stock is often discussed as though it were of itself the most self-contained aspect of stock-production. Many farmers feed their stock poorly in winter and get profitable returns, while others, who feed better in winter, get poorer returns. A consideration of these and allied facts makes it evident that winter feed must be considered not only by itself, but also in relation to the kind and quality of feeding, and the returns therefrom, during the whole year. The returns of butterfat per acre, per cow, or the cost of production per pound of butterfat are often used as measures of the level of production, and as such these are excellent standards of performance. They are not so helpful as to the reasons for high or low production. A more informative line of approach which displays both cause and effect is the lactation-curve.



LACTATION-CURVES.

From an examination of the records of milk-recording societies in 1875 Gavin in England made a beginning with lactation-curves, and

* Substance of paper presented at the Conference of New Zealand Grassland Association at Christchurch, August, 1935.

these have since been further investigated in America and in England. A lactation-curve is a statement in the form of a graph, giving, in monthly or weekly periods, the yearly production of a cow, in pounds of butterfat, or pounds or gallons of milk. In the following, pounds of butterfat per month are used. It has been established that normal, well-fed cows attain their maximum production in the sixth to the eighth week after calving, and fall off in subsequent months at the rate of from 9 per cent. to 11 per cent. Thus for a production period of nine months the following would represent the normal yearly butterfat-production of cows at different levels. The lactation-curve of a Canterbury herd yielding 296 lb. of butterfat in eight months is also given.

While these curves are this shape for herds they may show much variation for individual cows. Some cows milk at the same rate for the whole twelve months, and others give 250 lb. fat in from four to five months, and then dry off. These are exceptions, since an examination of the performances of many herds makes it evident that the existence of such individual cows in no way invalidates the statement that lactation-curves of normal, well-fed herds conform to the shapes outlined above.

Graphs are difficult to reproduce, and for convenience throughout this paper the material will be presented in tabular form. The information in the preceding graph is set out in Table I.

Table I.

—	Pounds of Butterfat per Month of Normal Cows of Different Capacity (in Nine Months)				One Herd in Canterbury, 1930
Augus	20	30	40	50	..
September	25	35	45	56	40
October	22·5	31·5	40·5	50·4	50
November	20·2	28·4	36·5	45·4	56
December	18·2	25·6	32·9	40·9	43
January	16·4	23·1	29·7	36·9	38
February	14·8	20·8	26·6	33·3	31
March	13·4	18·8	24·2	30·0	26
April	12·1	17·0	21·8	27·0	22
	162	230	297	370	296

These data are given for the purpose of demonstrating the fact that butterfat production at any level is not by nature a haphazard process. Some cows, even if well fed, are low producers, such as in column 1—162 lb. Most cows are low producers because of a departure from the above figures in two ways—first, through failure to reach maximum production until the third or fourth, or even fifth, month of the milking-season; and, second, through not milking for nine months. Of the cows examined in Canterbury, approximately 20 per cent. are good cows, sufficiently well cared for to be producing almost to their maximum. The returns of one such herd are set out in the last column. About 60 per cent. are equally good cows, but low-producing through unsuitable circumstances, and the remaining 20 per cent. are

naturally low producers. The above statement, as well as any that follow, is not meant to be a condemnation of Canterbury dairy-farming. It is a statement of the existing position. The information available does not allow of any comment on the profitableness of low or of high production. It does indicate the more important factors of cow-production.

LACTATION-CURVES OF CANTERBURY HERDS.

During the years 1927, 1928, 1929, and 1930 the records of the production of a number of herds in Canterbury were investigated. A dairy company supplied the sales of butterfat, and herd-owners supplied calving-dates and numbers of cows milked each month. By dividing pounds of butterfat each month by the number of cows in milk each month for every herd, lactation-curves are obtained. This is an easy non-technical process. Some difficulty is experienced at the beginning and at the end of the milking-season, when the number of cows in milk varies from day to day, but, if records of calving and drying-off dates are kept, it is not difficult to find the average number of cows in milk for these months from the total cow-days of milking, divided by 30. If allowance is made for whole milk or butterfat used on the farm, the record will be so much the more accurate.

The pounds of butterfat produced by herds in Canterbury per cow in milk each month are set out in Table II for years 1927 to 1930.

Table II.—Canterbury Herds Four Years' Average Butterfat Production per Cow per Month.

Month.	1927.	1928.	1929.	1930.	Fifteen Herds recorded in 1927.	Fifteen Herds recorded in 1930.
August	10·1	12·3	16·9	17·0	11·9	22·0
September	20·9	25·3	25·4	26·6	22·6	29·0
October	29·1	28·4	32·8	33·2	30·4	36·1
November	31·9	31·1	33·0	34·8	33·4	35·0
December	30·6	32·7	34·0	34·2	32·2	35·0
January	27·8	30·4	31·8	31·9	29·9	33·0
February	22·6	23·5	26·1	28·2	24·0	29·1
March	19·9	22·6	23·7	25·7	22·0	26·6
April	13·6	17·6	20·4	19·4	14·9	20·0
Totals	206·5	223·9	243·7	251·0	221·3	266·8
Number of herds	76	67	41	31	15	15

It will be seen that in every year the cows reach their maximum in November or December, and that from December onwards their production rate is comparable to that of 300 lb. cows (Table I).

In 1928–30 the production per cow in the last five months is 139 lb., 136 lb., and 127 lb. respectively. That of a 300 lb. cow is 135 lb. during the same period.

Canterbury cows are about 50 lb. to 60 lb. below their maximum nine-months-producing capacity, and this loss occurs in the first four months of the milking-season.

Some contend that the December or November maximum is a false one, due to late calvers that are in good condition and therefore high producers. Against this, the fact that production falls off after December in a normal way is presumptive evidence that there is nothing abnormal about the peak production. If it is admitted that high production is due to good condition of the cow, the critics and the writer are in agreement.

It will be seen from the totals that there is an improvement of 44·5 lb. butterfat per cow from 1927 to 1930. This may be due to the accidental examination in 1930 of better herds—*i.e.*, farms, or farmers, or better cows—than those examined in 1927.

As evidence that this is not the case, all the herds (fifteen) that were recorded in 1927 and again in 1930 were grouped each year, and the results are set out in the last two columns of the above table. These show an improvement of 45·3 lb. of butterfat and eliminates the factor of different farms, &c. Again, the improvements may be due to better cows. These fifteen herds contained 168 cows in 1927 and 180 cows in 1930, and it is reasonable to suppose that some of the 1927 cows were milking in 1930. None of these fifteen owners herd-test. Any replacements in these herds would be made with the same judgment or selection in 1930 as was used prior to that date, and new cows would therefore be of the same quality as cows already in the herds. The remaining and most probable cause of improvement is through better feeding, presumably occasioned by a consideration of information obtained from their own lactation-curves as supplied to them while the investigation was in progress.

Length of Time in Milk.

The second factor contributing to low production is a short milking-season. Some dairymen delay the calving of their cows until there is an adequate feed-supply, but all their cows calve in one month ; others spread the calving over three or four months.

The practice may mean profitable dairying, but it is inimical to high production. Information about the length of time in milk of Canterbury cows is set out in Table III. This table has been prepared by finding the total cows in milk each month, calling the best month 100 and expressing all other months as a percentage of this.

Table III.—Percentage of Cows in Milk each Month.

Month.	Canterbury Herds in				1928.	
	1927.	1928.	1929.	1930.	Twelve Herds producing 136 lb. Butterfat.	Twelve Herds producing 266 lb. Butterfat.
August	25	19	20	12	5·5	29·0
September	47	44	47	52	34·0	67·0
October	77	77	80	86	69·0	92·0
November	93	94	97	92	90·0	96·0
December	100	100	100	98	96·0	100·0
January	100	100	99	100	100·0	100·0
February	98	100	99	99	99·0	100·0
March	96	96	95	97	97·0	98·0
April	92	96	93	95	86·0	98·0
Totals	728	726	730	731	676·0	780·0

In every year there is a gradual increase in the percentage of cows in milk each month, until the fifth or sixth month, when all cows have calved. There appears to be no lengthening of the season from 1927 to 1930. From the totals it is seen that in a nine-months season there is an effective milking-season equivalent to all cows for a period of 7⅛ months—*i.e.*, about 80 per cent. of full-time efficiency. In actual production it means a loss of only about 10 per cent. owing to the fact that in the early part of the season those cows that are milking produce at a low level. The last two columns of Table III were obtained from the returns of the twelve lowest-producing herds and the twelve highest-producing herds in 1928. It will be seen that the high producers milk one month longer than the low producers, and half a month longer than the average.

Just as test and quantity of milk combine to give the product "butterfat per cow" so length of lactation and rate of production per month combine to give the same thing. The latter two factors are the only related variants in total yield that react to man's treatment of the animal.

Herd-testing has supplied information about individual cows in the herd, and also about length of lactation and production-levels from month to month. Probably its greatest value arises from the latter two pieces of information.

Length of lactation and rate of production, though variants in herd production, are not prime causes in it, since both are the effects of feed-supply and are controlled only by this. Consideration of the feed-supply is therefore of some importance.

FEED-SUPPLY.

For the purposes of translating tables of butterfat-production into tables of yearly feed-supply it is necessary to use the fundamental facts that the maintenance of a 1,000 lb. cow is 6 lb. of starch-equivalent per day—less for correspondingly lower weights—and that every pound of butterfat requires 6 lb. of starch-equivalent for its production. Using these figures, the feed-requirements for one month for a 1,000 lb. cow producing 40 lb. butterfat is 180 lb. of starch-equivalent for maintenance and 240 lb. starch-equivalent for production—a total of 420 lb. of starch-equivalent.

Cows that produce at their maximum capacity do so only when their weight remains constant within narrow limits throughout the year. Those producing below their maximum frequently do so because their live weight changes considerably (by perhaps as much as 30 per cent.). Thus cows of 1,000 lb. weight may come down to 700 lb. towards the end of the milking-season and during the winter and build up this 300 lb. as soon as grass is available in spring and early summer.

The first use to which spring feed is put by these cows is to build up body-reserves, and they cannot milk to capacity and store body-weight at the same time. For purposes of illustration it is assumed that the high producer maintains a constant weight and that the low producer varies in weight from month to month as indicated.

Few will dispute that a cow does vary in weight. No one is asked to believe that it does so according to the standards here set down as an example. Feed-supply—*i.e.*, the season—determines weight-change in amount and time.

Table IV sets out feed-supply of high and low producers in detail, allowing for weight-changes of the low producers and for variable maintenance appropriate to their weight. For the storage of 1 lb. of live weight, 2 lb. of starch-equivalent are required; the same weight lost gives out 1·66 lb. of starch-equivalent for production or for maintenance.

Table IV.

	High Producers: 300 lb. Butterfat, from Table I.				Low Producers: 206 lb. Butterfat, from Table II (1927 Group)					
	Starch-equivalent for					Starch-equivalent for				
Month.	Maintenance.	Production.	Total.	Percentage of Year's Total.	Live Weight.	Maintenance.	Production.	Change in Live Weight.	Total.	Percentage of Year's Total.
					lb					
August ..	180	240	420	10·3	700	142	61	..	203	6·2
September	180	270	450	11·1	700	142	125	..	267	7·9
October	180	249	429	10·5	800	156	175	+200	531	15·8
November	180	222	402	9·9	900	169	191	+200	560	16·6
December	180	200	380	9·3	1,000	180	183	+200	563	16·7
January	180	181	361	8·6	900	169	166	−166	169	5·0
February	180	162	342	8·4	800	156	133	−166	123	3·6
March ..	180	146	326	8·0	850	163	119	+100	382	11·4
April ..	180	132	312	7·6	850	163	81	..	244	7·3
May ..	180	20*	200	4·9	800	156	20*	−83	95	2·8
June ..	180	40*	220	5·4	750	149	40*	−83	106	3·2
July ..	180	40*	220	5·4	700	142	40*	−83	99	2·9
Totals	2,160	1,902	4,062	..	..	1,887	1,334	..	3,346	..

* For production of calf.

The intake of the high producers is limited by their capacity to produce milk, while that of the low producers is limited by their stomach-capacity. This table is set out in full for the purpose of letting those interested see how the figures in the percentage columns are arrived at. There are differences that appear small, but in the following table it will be seen how important these differences are. Table V has been prepared by using the percentage columns of Table IV and setting down in columns 3, 4, and 5 the average, maximum, and minimum grass-growths each month as a percentage of total growth obtained over a four-year period at Lincoln College.

It will be seen from Table V that the monthly feed-requirement of the high producers, maintained at constant weight, shows little variation from month to month. It reaches a maximum in September and gradually falls off to a minimum in May. It is quite unrelated to grass-growth, and therefore has been arranged by the owner of the cows.

That of the low producers varies considerably from month to month, reaches one maximum in November and December, another in March, and drops to low levels in February and in May to June. It actually follows the graph of grass-production. In fact, the variations in grass-growth or other feed-supply determine the variations in live-weight change. The differences are well displayed in graphical form.

The low-producing cow, second column in Table V, loses weight during January and February while milking, gains a little in March when

the grass is better, and then loses weight in June and July. In October November, and December she returns to her normal weight. In doing this she uses much more feed than the constant-weight high producer in spring, and very much less feed in autumn. Some dairy-farmers maintain that this practice has many advantages, since it tends to keep grass-growth under control in spring, and certainly gets over the difficulty of poor grass in early autumn. By comparing columns 2 and 3 of Table V it appears, however, that on an average such a cow cannot eat all the grass that grows in November and December, and therefore that some waste must occur even in average seasons (a little hay is made).

Table V.—Percentages of Feed-requirement and Grass-growth for Twelve Months.

	Feed required each Month by Cows producing		Percentage of Grass-growth each Month for Four-year Period, 1927 to 1930.		
	300 lb.	206 lb. (1927 Group).	Average.	Maximum.	Minimum.
August	10·3	6·2	2	6	1
September	11·1	7·9	5	10	1
October	10·5	15·8	15	30	10
November	9·9	16·6	25	35	10
December	9·3	16·7	20	30	10
January	8·6	5·0	7	40	2
February	8·4	3·6	5	20	2
March	8·0	11·4	8	20	2
April	7·6	7·3	4	10	..
May	4·9	2·8	3	10	..
June	5·4	3·2	2	10	..
July	5·4	2·9	2	6	1

Maximum and minimum grass-growths are included in columns 4 and 5 to show the enormous variations that may take place in grass-growth and to emphasize the point that even though animals can be sufficiently accommodating to use the average grass-growth there are such wide departures from the average of monthly growth in different years that there must be waste of grass or starvation of cows unless reserves of feed are put by.

To some extent the low producer of varying live weight obviates the necessity of cutting hay or silage, but she also precludes the possibility of doing so, and consequently such cows that are in poor condition in winter give themselves the legacy of being low-producing in the following spring and of being starved in autumn. It therefore becomes difficult, and perhaps inadvisable, to lay the blame of low production at the door of winter feeding. It might be more reasonably charged against the general farm policy and the absence of feed in January and February, May and June, or other months when grass, the staple food, is in short supply. Wordsworth's lines, " Getting and spending, we lay waste our powers," might have been meant for the dairy cow.

It is an age-old practice, most convenient to mankind and indispensable to the very existence of the animal, for the animal to use its body as a storehouse for its own feed-supply. The more highly exploited and artificial the existence of the animal the more it is necessary for man to organize its feed-supply, and, if dairy cows are to be high-producing, organization of the feed-supply is a most urgent problem. Attention to this by those interested in the industry has already been the biggest

factor in success, and it must be productive of the most immediate progress where it is now not adequately attended to. Evaluation of the aptness of the present feed-supply can be made most easily from a consideration of the herd lactation-curve, or from information obtained from actual measurement of cows, as an index of live-weight status.

When animals are used excessively as storehouses it not infrequently happens that, owing to the apparent need of a winter-feed supply, undue expense is incurred on this in a tardy attempt to build up the animal that has become too low in condition, with a consequent reduction in the grass-area or spring-feed supply, and therefore a reduction in the output of saleable animal products.

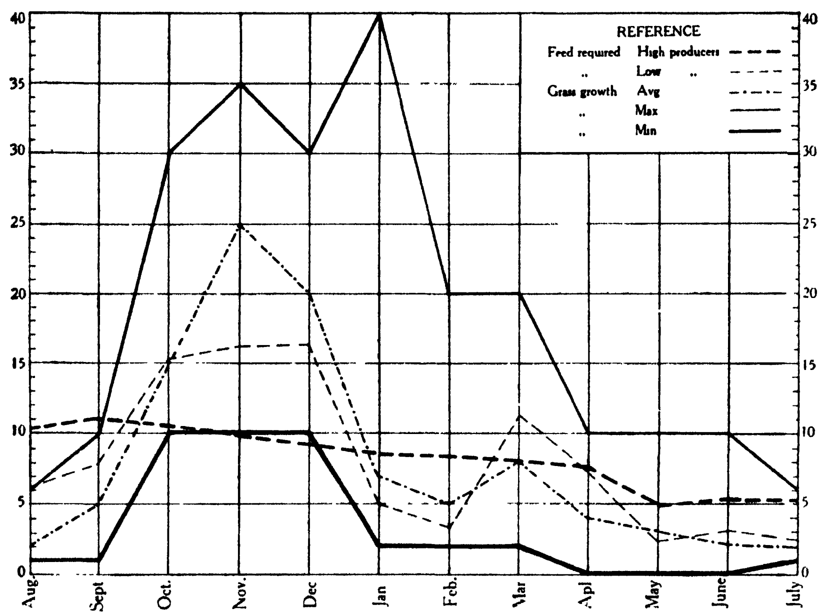


FIG. 2. GRAPHICALLY DEPICTS THE DATA CONTAINED IN TABLE V.

Efficiency of Feed Conversion

One further aspect of feed utilization that may negative the value of otherwise excellent feeding is the amounts of feed that are used for maintenance and for production purposes. Those who keep cows do so for profit, and usually attempt to keep such a number that their profits are as great as possible. In his bulletin, No. 138, New Zealand Department of Agriculture, on dairy-farm management, Fawcett produced figures to show that the greater the number of cows per acre the greater the production per acre, that cows per acre is a cause of returns per acre, and that high-producing cows, while valuable, tend to be over-exploited as a factor in high per-acre production. His contentions require consideration in the light of fundamental principles.

Reverting to Table IV, it will be seen that the high producers consume 4,062 lb. of starch-equivalent, and convert 1,802 lb. of these into butterfat (100 for calf-production). This means that they are converting

44·5 per cent. of all the feed that they eat into butterfat. The butterfat production on any farm is determined by two most basic factors, both under the control of the owner. The first is the amount of feed that grows and the second the percentage of this that is turned into butterfat.

The owner has some control over the first by the kind of pasture or crop he uses, and the top-dressing and treatment he gives them ; over the second by the quality of the cow he uses, the number he keeps, and the way he organizes their feed-supply. Cockayne first indicated the importance of this aspect of cow production in the *New Zealand Journal of Agriculture*, Vol. XXIII, p. 65, and most dairy-farmers were quick to realize the importance of reducing the number of cows in order to get higher total production of butterfat. Fawcett appears to have drawn a wrong inference when he suggests that high production per acre is due to high cow-numbers per acre. If we take Table I of his bulletin and translate his cow-numbers and pounds of butterfat per acre into feed produced per acre, we get the following :—

Table VI

Average Butterfat per Acre. Bulletin No. 138, Table 1.	Feed used per Acre for producing Starch-equivalent. (In Pounds.)	Cows carried per Acre. Bulletin No. 138, Table 1.	Feed used per Acre for Cow-maintenance (In Pounds, Starch-equivalent.)	Total Feed produced per Acre. (In Pounds, Starch-equivalent.)	Percentage turned into Butterfat.
	Butterfat × 6.		Cows × 2,200		
161·9	971	0·535	1,177	2,148	45·2
139·0	814	0·490	1,078	1,892	43·0
119·5	717	0·440	968	1,685	42·5
99·6	597	0·382	840	1,437	41·1
81·9	491	0·338	743	1,234	39·8
63·8	386	0·293	644	1,030	37·5
38·0	228	0·198	435	663	34·4

It will be seen that the farms compared vary in production per acre from 2,148 lb. of starch-equivalent down to 663 lb. of starch-equivalent per acre, and the percentage of this that is turned into butterfat varies from 45·2 per cent. on the high-production farms down to 34·4 per cent. on the low-production farms. If the efficiency of conversion of the lowest-producing farms was as good as that of the highest-producing, the lowest-producing farms would be carrying 0·164 cows to the acre and producing 50 lb. of butterfat per acre, an improvement of about 30 per cent. in per-acre production by reducing cow-numbers per acre by about 16 per cent. The fact that high correlations are obtained between butterfat per acre and cows carried per acre means little, since both these items are merely consequences of the amount of grass that grows and of the efficiency with which it is converted into butterfat. The percentage of grass turned into butterfat on average dairy-farms would appear to be about 40 to 42 and the maximum about 50 to 52 for farms quoted in Bulletin No. 138. Some slight improvement is still possible in this direction, even in the North Island. If the number of cows in milk is multiplied by 2,200, and the pounds of butterfat sold multiplied by 6, the sum of these two amounts is the total feed used by the cows. The precentage efficiency is then found by dividing the product " butterfat multiplied by 6 " by the total feed used. When a man knows this efficiency he knows how much attention to give to his feed-supply.

THE POTATO-TUBER MOTH.

(*PHTHORIMAEA OPERCULELLA*, ZELL.)

J. MUGGERIDGE, Entomologist, Plant Research Station, Palmerston North.

THE potato-tuber moth, *Phthorimaea operculella* Zell. (*Lita solanella* Boisd.), referred to by Kirk in a departmental leaflet published in 1894, had apparently been in New Zealand for a considerable number of years prior to this date. Its importance as a pest during any year is influenced largely by climatic conditions, dry seasons especially favouring its increase and consequently its destructiveness. During the long dry summer of 1934–35, for example, the moth increased enormously and caused considerable losses to potato-growers, especially to those near Auckland

THE DIFFERENT STAGES OF THE MOTH.

The adult insect is a small, inconspicuous, greyish, night-flying moth which measures approximately ½ in. in length. It is a weak flier, and when it is disturbed it travels but a short distance, pursuing an erratic course from one plant to another in an endeavour to conceal itself. It lays its small, rounded, pearly-white eggs on the leaves or stems of the host-plant, or they may be laid in cracks or in the eyes of the potato-tuber itself. The small whitish larva or tiny caterpillar which emerges from the egg measures approximately $\frac{1}{25}$ in. in length, and when full-grown it is $\frac{7}{16}$ in. to ½ in. long. The full-grown larva has a dark head capsule ; the first two thoracic segments are light brown in colour, while the remainder of the body may be white or tinged a faint greenish or pinkish colour. The larva is very active and wriggles violently when disturbed. When ready to pupate the caterpillar leaves its burrow or mine and pupates in the soil, or among plant debris, or even between leaves of the host-plant, which it firmly ties together by means of numerous fine silken strands. Under storage conditions it pupates amongst the potatoes or on the sides of the bag or bin or other container in which the potatoes are kept. The pupa, from which the moth later emerges, is a small, spindle-shaped object which is usually protected by a finely-woven silken cocoon.

LIFE-CYCLE.

Specific life-history studies of the insect in New Zealand have not been made, but all stages of the moth may be found throughout the different seasons of the year. In the United States of America Spencer and Strong (1925) have shown (Table A) that the length of the life-cycle of the moth may vary from 27 to 159 days ; they found that the cycle shortens as the mean temperature rises.

Table A.—Table showing Temperature Influence on Length of Life-cycle of the Moth (Egg to Adult)

Series.	A.	B.	C.	D.
Temperatures, degrees F.				
Maximum	69	78	82	79
Minimum	38	52	63	65
Mean	56	65·4	70·5	72·2
Life-cycle, days—				
Minimum periods egg to adult..	55	36	35	27
Maximum periods egg to adult	159	75	50	45

—After Spencer and Strong.

INJURY.

All portions of the potato plant—*i.e.*, the stems, the leaves, and the tubers—are subject to attack by the moth. Injury to the stems is caused by the larvæ burrowing into them; this has the effect of checking the flow of plant-sap, and thereby causes the plants to wilt and die. The characteristic blistered appearance of the leaves is brought about by the larva boring into them and eating out the tissue between the upper and lower surfaces. Leaves of tobacco are attacked in a similar manner, with the result that the mines formed weaken the tobacco-leaves and cause them to split when used as "wrappers" of cigars. It is for this reason that it received the name of "tobacco split-worm" in the United States of America. Until recently it was thought that the tobacco split-worm was possibly a different insect from the potato-tuber moth, but the work of Spencer and Strong (*loc. cit.*) on cross-breeding and life-history experiments, coupled with careful morphological comparisons of adult specimens, showed that they were identical.

Attacks on the tubers may take place in the field, but only those which are exposed by cracks in the ground, or through poor "earthing up," are likely to become infested. The larvæ usually seek some depression or dent in the potato-surface in which to commence boring, the potato-eyes, for example (Fig. 1), being favoured points of entry. Once inside the tuber they appear to bore indiscriminately through the flesh; the burrows formed become packed with frass and permit the entry of disease organisms, which subsequently cause the potato to decay. Typical tuber-injury by the grub is shown in the accompanying figure (Fig. 2).

PREVENTIVE MEASURES.

The time-worn phrase "prevention is better than cure" is equally important as a means of preventing damage by the potato-tuber moth as it is for the prevention of damage by many other insect pests. The ground should be cultivated to a fine tilth before planting the potatoes; unless it is thoroughly worked it tends to crack and open up during a dry spell, thus providing an entrance for the moths or their larvæ, these latter frequently migrating from the withered tops in search of a fresh food-supply. It is advisable to plant clean seed; planting should be deep, and during the growing-period the potatoes should be well hilled.

Before digging-operations commence, especially in a field where the moth is very prevalent, it is advisable first to go through the crop and remove and bag exposed tubers, which are almost certain to be infested by the pest. Following digging-operations the potatoes should be bagged immediately; the bags should then be sewn up and removed without delay to suitable storage. The practice of covering the mouths of the bags with potato foliage and allowing them to stand in the field cannot be too strongly condemned, since the grubs are likely to leave the foliage and infest the potatoes in the bags. Growers should take every precaution to prevent storage infestation by the moth since it is likely to do more damage under such conditions than elsewhere.

Following the harvesting operations all old potato-foliage left lying about should be raked up and burnt. Similarly, all cull potatoes

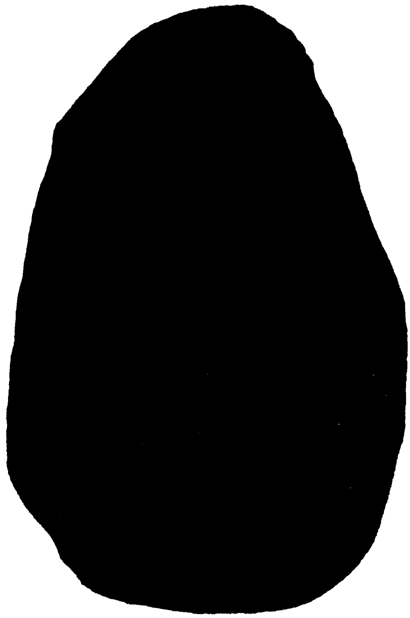


FIG. I. THE DARK PILES OF FRASS IN THE POTATO-EYES INDICATE PLACES OF ENTRY BY THE LARVÆ.

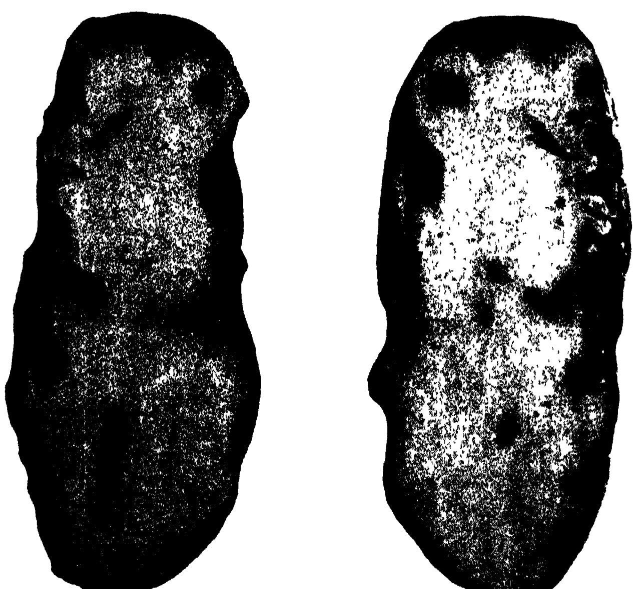


FIG. 2. POTATO CUT IN HALF TO SHOW TUBER-MOTH INJURY.

should be collected and in some manner, such as feeding them to pigs, they should be completely disposed of. Field sanitation-methods and the removal of stray potatoes, whether from field or from round about the places of storage, are all important aspects of prevention which are commonly neglected.

Control Measures.

In spite of the many precautions taken an outbreak of the pest occasionally occurs, and in order to control it the use of a fumigant such as carbon bisulphide may prove necessary. Until detailed experiments are carried out concerning the ultimate effect of carbon bisulphide on seed potatoes its use for this purpose seems inadvisable at present. Storage tubers, however, may be treated with carbon bisulphide at the rate of 5 lb. of the liquid to every 1,000 cubic feet of space to be fumigated. The period of time over which the potatoes are exposed to the fumigant should not exceed eighteen hours. Excessive quantities of the fumigant or extended periods of exposure to its action may cause the complete collapse of the potato flesh. Carbon bisulphide is highly inflammable and explosive when mixed with air, and for this reason must be used with caution. A flame of any kind, a lighted cigarette, or even a spark from hitting metal on metal, or from an electric switch, may cause an explosion of the gas. Carbon bisulphide causes dizziness and nausea if inhaled and is fatal if breathed in sufficient quantities; it has a deleterious action on the heart, so that people with weak hearts should not handle it. Since the fumigant is more than two and a half times heavier than air and tends to fill a room in very much the same way that water would fill it, the room should be made as air-tight as possible, especially around the sides and bottom.

Fumigation may be conducted in the field by loosely stacking the potatoes and covering them with a large tarpaulin the edges of which should be carefully covered all around with loose earth. It is inadvisable to fumigate with the temperature below 60° F., and best results will be obtained at temperatures from 75° to 90° F. A second fumigation may be necessary in ten or fourteen days in order to kill any larvæ or moths which might emerge from the eggs and pupal stages.

Seed Potatoes.

The grower who keeps his own seed potatoes should select only clean material, which should be kept bagged and stored in a place free from the moth. The practice of greening the seed by spreading it out in the open during the autumn or warmer months of the year must be strongly condemned as such a practice is conducive to serious moth attacks. The greening operation should be delayed until the cold weather sets in, when the moth is inactive and unlikely to spread.

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FARMERS' FIELD COMPETITIONS.

CANTERBURY (NORTHERN A. AND P. ASSOCIATION) RESULTS, 1934–35 SEASON.

J. G. McKAY, Fields Instructor, and C C. LEITCH, Instructor in Agriculture, Christchurch

THESE competitions were continued as in previous seasons and embraced turnips, mangolds, green feed, and lucerne. Turnips included both white-fleshed and yellow-fleshed varieties all judged as one class, the comparatively small number of entries usually received hardly warranting a distinction being made between varieties. In the mangold competition provision was made this season for two classes, one on land of any value and the other on land valued at less than £25 per acre. Green-feed crops were divided into two classes, including crops on land of any value (the value of the land to be taken into consideration), and those on land of any value from which a grain crop has been taken during the season. The lucerne competition comprised stands of varying ages all judged as one class.

TURNIPS.

Turnip entries totalled four, as against six for the previous season, and yields were on the average lower, there being a difference between the two winning crops of 11 tons per acre in favour of last season. These differences are to some extent attributable to seasonal conditions, but it is interesting to note that the crops placed first and second last season were sown in 7 in. instead of 14 in. rows, a factor which may have a considerable influence upon vield, as indicated by experiments conducted by the Department in Canterbury and elsewhere, the results of which are supported by weighings taken in these field competitions, where turnips sown in 7 in. rows have invariably yielded better than those in 14 in. rows on similar soils and methods of cultivation.

The winning crop was grown by Mr. F. A. Sheat, Horrelville, Mr. C. Lassen, Oxford, being second, and Mr. R. F. Henderson, Oxford, third. The crop securing first place consisted of a mixture of Imperial Green Globes, Red Paragons, and Green Top Yellow Aberdeens, sown early in January at the rate of 7 oz. per acre through alternate coulters of the drill (14 in. rows) with carbonate of lime and superphosphate mixed in equal parts at the rate of 1 cwt. per acre. The crop followed green feed; the land was ploughed early in October and received six grubbings and one stroke each of harrows and grubber prior to sowing. Second place went to a crop of Imperial Green Globes sown on land ploughed out of old grass pasture in August. A good seed-bed was prepared with disk harrows, cultivator, and tine harrows; the land was rolled, and 8 oz. of Imperial Green Globe seed was sown early in January through alternate coulters of the drill, with superphosphate and carbonate of lime mixed in equal parts and sown at the rate of 2 cwt. per acre.

The crop placed third also followed grass. The land was ploughed in September, a seed-bed was prepared with disks, grubber, and harrows, and 11 oz. of Green Top Yellow Aberdeen seed per acre was sown early

in January through alternate coulters of the drill, with carbonate of lime and superphosphate mixed in equal parts and sown at the rate of 2 cwt. per acre.

Points awarded the winning crops were as follows:—

Competitor.	Distance between Rows.	Variety.	Yield, in Tons.	Yield Points: 60.	Quality: 20.	Evenness of Crop: 10.	Freedom from Weeds: 10.	Total: 100.	Placing.
	In.								
F. A. Sheat, Horrelville	14	Imperial Green Globe, Red Paragon, Aberdeen Green Top Yellow	29	50	18	8	9	85	1st
C. Lassen, Oxford ..	14	Imperial Green Globe ..	25	46	20	9	9	84	2nd
R. F. Henderson, Oxford	14	Aberdeen Green Top Yellow	27	48	18	8	6	80	3rd

These crops were judged in May, and the roots at that time were practically free from dry rot. All were sown about the same time, early in January, and contrary to what might be expected Imperial Green Globes were in some instances superior in quality to Aberdeen Green Top Yellows, the latter variety having become somewhat spongy. In one instance a small percentage of club-root was present, due to growing cruciferous crops too closely in the rotation. In North Canterbury this disease is not regarded so seriously as in other parts, but the case mentioned emphasizes the advisability of keeping such crops fairly wide in the rotation.

The carbonate of lime and superphosphate mixture used with all three crops has given such satisfactory results as a fertilizer for turnips and similar crops in Canterbury that its use has become fairly general.

MANGOLDS.

In the mangold competition a total of eleven crops were entered, being one less than last season, and, as previously stated, an additional class was provided for, on land valued at less than £25 per acre. Some exceptionally good yields were recorded, the winning crop on the higher-priced land yielding 130 tons per acre, a phenomenal yield for Canterbury, whilst yields on the lighter soils compared more than favourably with the best in the turnip competition. Considering the dry season experienced, yields as a whole were remarkably good, and crops in the main were very even and comparatively free from weeds.

In Class 1 (land of any value) the placings of the competitors were—Estate of R. Petrie, Woodend, first; R. McDonald, Waikuku, second; and A. J. Rich, Kaiapoi, third.

First place went to a crop of Yellow Globes sown in 20 in. rows without fertilizers. This was an exceptionally heavy crop, and followed potatoes.

A crop of Prizewinner Yellow Globes gained second place. This crop was sown on land ploughed out of grass, and received superphosphate and carbonate of lime at the rate of 2 cwt. per acre as a fertilizer. This crop was somewhat uneven owing to dry weather in the early stages of growth.

Third place was secured by a crop of Rich's Intermediates sown in 23 in. rows without fertilizers on land which had grown an onion crop the previous season. This was a very even crop, and was practically free from weeds.

Class 2, on land valued at less than £25 per acre, drew three entries only, and placings were—H. E. Evans, Fernside, first; W. Atkinson, Ohoka, second; and J. F. Dawson, Fernside, third.

In this class Golden Globes secured first place. The crop was sown in 28 in. rows, with superphosphate at 2½ cwt. per acre and approximately 2 tons per acre of farm-yard manure.

A crop of Orange Globes secured second place. The crop which was sown in 28 in. rows had a higher yield than the crop placed first, but was not so even or so free from weeds.

Third place also went to a crop of Orange Globes sown in 28 in. rows, with 6 cwt. of super drilled and broadcast This was a very clean, even crop, but suffered from lack of moisture.

Placed crops in these two classes are as follows:—

½ Acre Mangolds · Land of any Value.

Competitor.	Distance between Rows, in Inches.	Variety.	Yield, in Tons	Yield in Points: 60.	Quality: 20.	Evenness of Crop 10	Freedom from Weeds: 10	Total: 100.	Placing.
	In								
Estate R. Petrie, Woodend	20	Yellow Globe ..	130	60	17	8	9	94	1st
R McDonald, Waikuku	20	Sutton's Prizewinner ..	120	55	18	7	8	88	2nd
A J. Rich ..	23	Rich's Intermediate ..	93	41·5	10	10	9	70 5	3rd

Green-feed Crops.

In the green-feed classes some good areas of feed were to be seen, and the total of twelve entries can be regarded as satisfactory considering the comparatively dry season.

It may be stated that no competitor has so far grown a green-feed crop specifically with the object of entering it, or portion of it, in these competitions, and it naturally follows, therefore, that a competitor who happens to be utilizing a field in particularly good heart, such as grassland under fallow, has an advantage over others who of necessity, or other reason, are growing on land after a grain crop, perhaps necessitating a more or less hurried preparation of the land for green feed. The benefits of early and thorough land-preparation cannot be denied, but whether feasible or economically sound in all instances are questions which the farmer himself is best able to decide.

Class 1: Best 5 Acres Green Feed (Land any Value), Value of Land to be taken into Consideration. Nine Entries.—The winners of this class

were H. B. Catherwood, Springbank, first; R. L. Anderson, Bennets, second; M. Spencer-Bower, Swannanoa, and Frizzell Bros., West Eyreton, third (equal).

Mr. Catherwood sowed Algerian oats on land ploughed out of grass in October. Following cultivation with grubber and harrows, the area was again ploughed in February, a seed-bed prepared, and sown with 2 bushels of Algerian oats and 1 cwt. of turnip manure per acre.

Mr. Anderson sowed Italian rye-grass (certified) on land which had grown a wheat crop the previous season. The land received three ploughings in all; a seed-bed was prepared with grubber, harrows, and roller, and 25 lb. of Italian rye-grass per acre was sown broadcast in March, with 1 cwt. of superphosphate.

Frizzell Bros. sowed Algerian oats on land ploughed out of grass in October. The land received a further ploughing in December, and the oats were sown about the middle of February at the rate of 2½ bushels per acre, with ¾ cwt. of superphosphate.

Mr. M. Spencer-Bower sowed a mixture consisting of 1 bushel of perennial rye-grass, 1 bushel of oats, and 1½ lb. of rape on land ploughed out of grass in September. A seed-bed was prepared with cultivator and harrows and the seed sown early in March.

Points were awarded as follows:—

Competitor.	Strike Points. 30	Evenness: 20.	Condition and Yield. 25.	Freedom from Weeds: 25	Total: 100.	Placing.
H. B. Catherwood, Springbank	28	19	24	23	94	1st.
R. L. Anderson, Bennets ..	28	18	23	24	93	2nd
M. Spencer-Bower, Swannanoa	28	18	23	23	92	3rd equal
Frizzell Bros., West Eyreton	28	17	23	24	92	3rd equal

Class 2: Best 5 Acres Green Feed on Land of Any Value that has had a Grain Crop taken from it during the Season.—This class drew three entries only, and placings were—F. A. Sheat, Horrelville, first; Jas. Petrie, jun., Swannanoa, second; and G. H. Hassall, Clarkville, third.

Mr. Sheat's entry consisted of Algerian oats and Cape barley following a wheat crop. The land was ploughed immediately after harvest, worked down with tine harrows, and sown with 1 bushel each of Algerian oats and Cape barley about the end of February, with lime and superphosphate in equal parts at the rate of 1 cwt. per acre.

Mr. Petrie's entry consisted of perennial rye-grass and Algerian oats following an oat crop. The land was ploughed, grubbed, four times harrowed, and rolled three times, drilled and cross-drilled with 1 bushel each of Algerian oats and perennial rye-grass early in March, with superphosphate at the rate of 1½ cwt. per acre.

Mr. Hassall's entry consisted of Western wolths following an oat crop. The land was ploughed in February and a seed-bed prepared with cultivator and tine harrows. Western wolths at the rate of 1½ bushels per acre was drilled and broadcast early in March, with ¾ cwt. of superphosphate per acre.

Points awarded were as follows :—

Competitor.	Strike Points: 30.	Even-ness: 20.	Condition and Yield: 25.	Freedom from Weeds: 25.	Total: 100.	Placing.
F. A. Sheat, Horrelville ..	29	19	23	24	95	1st
Jas. Petrie, jun, Swannanoa ..	29	20	21	24	94	2nd
G. H. Hassall, Clarkville ..	28	19	20	24	91	3rd

LUCERNE.

The lucerne competition drew a total of eight entries, compared with ten last season, and the following points were awarded the winning stands :—

Competitor.	Purity: 25.	Quality of Crop: 25.	Density and Field Capacity. 50.	Total: 100.
G. M. Dixon, Amberley ..	24	24	46	94
A G Stewart, Coldstream ..	24	24	45	93
W Stalker, Rangiora	24	23	44	91

Entries comprised stands varying in age from one year upwards, and included some excellent areas of lucerne. Naturally the younger stands were at a disadvantage in competition with fully established ones, but the number of entries so far received in the competition has scarcely warranted a distinction being made, and it has therefore been the custom to include all crops in one class. First place went to a four-year-old stand showing plenty of vigour, and those placed second and third were both two-year-old stands which have not yet reached their maximum productivity.

The Fields Superintendent, Christchurch, advises that in many parts of Canterbury cocksfoot is coming into much greater favour than has been the case of recent years Many farmers on the plains, who have been endeavouring to grow only rye-grass pastures, find that under the normal summer climatic conditions of Canterbury the rye-grass does not produce any feed worth-while after about the middle of December and, in the case of the poor types of rye-grass, the greater part dies out during the periods of drought The certified rye in most cases holds on, but is quite dried up The cocksfoot pastures produce a certain amount of summer feed and very good early autumn feed, and for this reason cocksfoot is finding favour with many farmers who previously sowed nothing but rye-grass

Parasitic Disease in Young Cattle—The prevalence of parasitic disease in calves is responsible for considerable loss Much information on the prevention and treatment of the trouble has been disseminated, yet it is difficult to bring about a realization of the efficacy of good feeding and management. Referring to this point the District Superintendent, Auckland, remarks : " Parasitic diseases among young stock are far too common in spite of the information imparted to farmers on the prevention and treatment of these troubles. Owners are far too prone to rely on all kinds of medicines, but lose sight of the fact that good feeding and careful management, especially during the winter months, play a big part in assisting calves to overcome these troubles."—*Annual Report, Director, Live-stock Division.*

ELLESMERE FARM-MANAGEMENT COMPETITION, 1934-35.

UNDER THE AUSPICES OF AGRICULTURAL AND PASTORAL ASSOCIATION.

I. W. WESTON, Economist, Canterbury Agricultural College, Lincoln.

THE late Mr. Job Osborne donated the sum of £150 to the Ellesmere Agricultural and Pastoral Association to enable that association to award prizes for the best-managed farm in the district. A sub-committee, comprising Messrs. R. T. MacMillan, T. O. Stephens, W. O. Rennie, and, later, P. V. Bailey, was set up, and, working in conjunction with the writer, and after obtaining particulars as to the method of running similar competitions in Otago, Southland, and Palmerston North, the following conditions and rules were finally drawn up:—

1. Entries open to farmers resident in the Ellesmere, Springs, and Selwyn Counties farming an area exceeding 45 acres.
2. Competitions to be judged under the following headings:—

	Points.
(*a*) Land in good heart	100
(*b*) Farm conducted on a permanent plan	100
(*c*) Cleanliness of land and freedom from weeds ..	100
(*d*) Stock suitable to the farm	150
(*e*) Buildings, plant, fences, &c., in good order and suitable	150
Total general points	600
(*f*) General and profitable management of the farm (profit and loss)	400
Total points	1,000

3. Competitions to commence at the beginning of the financial year, about 1st July, and to close about 30th June, at the end of the financial year. Entry fee, 7s. 6d.
4. Information required from competitors to be treated as strictly private. No confidential information or details of private position required, but merely a record of the year's farm receipts and payments.
5. Prizes: Eight entries or more—1st prize, £15 15s.; 2nd prize, £5 5s. Less than eight entries—1st prize, £10 10s.; 2nd prize, £4 4s. Three entries, or no competition.

In 1933 three entries were received, and it was decided, with the consent of the competitors, to postpone the competition to 1934. In this year thirteen entries were received. Ten further tentative entries were received, but, owing to the very unfavourable season, particularly on the heavy land, these entries were withdrawn.

The judges appointed were Mr. McIntosh and Dr. Hilgendorf (in his absence, Mr. Calder) as judges of general points, and the writer in respect to profit and loss. The farms were inspected in November-December, and general points were awarded. At the end of the financial year the "profit and loss" points were added, and the five leading

farms again inspected for confirmation of the general marks previously awarded. The leading farm was Mr. A. C. Greenwood's (Southbridge), with Mr. J. Johnstone (Tai Tapu), Jos. Brooks (Irwell), and G. W. Tyson (Springston) next in that order.

In the judging of the profit and loss any possibility of individual bias was eliminated by basing the results entirely on returns such as are required for proper accounting. Certain adjustments were made to the Profit and Loss Account returns:—

(1) Any alteration of income due to the inclusion of returns for the previous year's production was allowed for.

(2) Irrespective of whether or not wages were actually paid, wage rates for permanent labour were standardized on a basis of—

10s. per week plus 15s. keep for each boy working between 15 and 17 years of age.

15s. per week plus 15s. keep for each boy working between 17 and 19 years of age.

20s. per week plus 15s. keep for each boy working between 19 and 21 years of age.

25s. per week plus 15s. keep for each man working over 21 years of age.

(3) Wages for the owner, occupier, or manager were allocated at the rate of £100 per annum plus 1 per cent. of the total assets handled—*i.e.*, where the total valuation of the land, stock, and plant was £10,000, wages of management charged would be £100 plus £100 —*i.e.*, £200 per year. This low rate was decided upon because it was considered that a farm worker who had the opportunity to lease a farm as a going concern would be advised to do so provided he estimated the rent would permit him to secure but little more than present wages.

(4) The land used, whether rented, indebted, or free of debt, was valued at a conservative present market-value basis—

Light plain land being valued at £3 to £5 per acre.
River-bed grazing being valued at £6 to £10 per acre.
Dry wheat land being valued at £15 to £25 per acre.
Heavy wheat land being valued at £25 to £40 per acre.

The majority of the heavy land was valued at £35 per acre, with some of the heaviest and best at £40 per acre.

The stock was valued at a standard low basis of £1 per head for sheep, £2 per head in the case of stud sheep, £5 per head for cattle, £10 per head for stud cattle, £2 per head for pigs, and £20 per horse carried.

Implements and plant were valued on a conservative basis.

(5) Since interest and land-tax vary according to the financial position of the occupier, both these items were excluded from the expenses. Depreciation, at standard rates, was included as an expense.

(6) From the gross farm income, say, £1,000, total farm expenses including wages of management, say, £600, were deducted, and the balance, say, £400, obtained. The balance was then expressed as the rate per cent. earned on the total valuation—*e.g.*, if the total valuation was £10,000 the rate earned on £400 = 4 per cent. of total valuation. For the year no return was higher than 10 per cent. For a return of 1 per cent. 40 points were awarded, so that a return of 10 per cent. would earn the maximum points, 400.

Average Results, 1934–35.

The following table summarizes the results obtained during the 1934–35 competition :—

——	Average, all Farms.	Four most profitable.	Four least profitable.
Acres (range, 50 to 600 acres)	256	242	212
Valuation of—			
Land (range, £3 to £40 ; average, £27 10s. per acre)	7,053	7,094	5,646
Sheep at £1, stud sheep at £2	445	690	200
Cattle at £5, stud cattle at £10 ..	120	70	100
Pigs at £2	7	3	10
Horses at £20	152	167	135
Implements and plant	413	286	305
Total stock and plant (average, £4 10s. per acre) ..	1,137	1,216	750
Total valuation (average, £32 per acre) ..	8,190	8,310	6,396
Gross income from—			
Cattle (range, £5 to £8 ; average, £7 per cow) ..	100	56	102
Sheep (range, 16s 8d to 27s. 6d. ; average, 23s. 6d. per head)	351	494	168
Pigs (range, £20 to £50 ; average, £24 per sow) ..	41	30	57
Horses (range, loss to £20 ; average, £2 10s per horse)	20	4	10
Total income from live-stock (average, 172 acres in grass and fodder crops = £3 per acre)	512	584	337
Crops (average, 84 acres in crop = £7 per acre)—Wheat, 37 acres at 28 bushels ; barley, 10 acres at 47 bushels ; peas, 15 acres at 17 bushels , ryegrass, 15 acres at 42 bushels , clover, 7 acres at 200 lb.	598	677	465
Total income (average = £4 7s. per acre) ..	1,110	1,261	802
Less farm expenses (average = £2 1s. per acre)	523	419	490
	587	842	312
Less wages of management (average, 14s per acre)	182	183	164
Balance (average, £1 12s per acre)	405	659	148
Balance expressed as percentage of total valuation ..	5	8	2·3
Points awarded	200	320	92

Remarks.

On the basis of the average returns set out above two further calculations can be made :—

——	Average all Farms.	Four most profitable.	Four least profitable.
(1.)			
Income (less farm expenses, excluding wages of management)	587	842	312
Less 5 per cent. interest on total valuation ..	410	415	320
Balance for management and profit	177	427	−8
(2.)			
Income (less farm expenses, including wages of management)	405	659	148
Balance capitalized at 5 per cent...	8,100	13,180	2,960
Less valuation of stock and plant	1,137	1,216	750
Balance, maximum amount on which interest-payment possible, on land at 5 per cent.	6,963	11,964	2,210
Balance equals a per-acre value of	£27	£49	£10

The number of acres per man working averaged 106.

With regard to the farm competition the following points may be noted: The most profitable farms for the year were the highest valued, had the highest investment in stock, the least investment in machinery, and the lowest costs. The winning farm grew a good yield of certified white clover and good yields of certified Italian and perennial rye-grass. Special care was taken to develop the land into good heart before sowing the white clover, and the success of this crop largely contributed to the success of the whole farm. This farm also grew much more lucerne than the other farms. A special use of mangels was made, the mangels being fed to the stock in the late spring so as to allow an extra paddock to be shut for grass-seed harvest. By extra care at lambing, special lambing-hutches being provided and the ewes being herded into small sheltered areas and inspected with the aid of a torch at intervals during the night, a large percentage of lambs was obtained from the stud Southdown ewes carried. The highest butterfat return per cow was also obtained from the Jersey cattle carried.

The main feature of the second farm was the high returns obtained from pigs and potatoes. A gross income of almost £100 was obtained from the production of two sows.

The third farm secured the second highest total for general points, but the season was not favourable to specially high net returns. The yields of wheat and of garden-peas were less than expected, but very good returns were obtained from the sheep, mainly Ryelands.

On the farm given fourth place Montgomery red clover with a rather low yield and a small area of wheat with a very high yield of over 60 bushels per acre comprised the crops grown. The land was maintained in excellent heart, and a large area was used for carrying ewes for fat-lamb production. The returns from fat lambs, even though from three to five ewes per acre were grazed intensively, did not, however, allow of a sufficiently high interest rate on land valued at £35 per acre. The table on page 96 shows that the income from stock averages £3 per acre, whereas the income from crops averages £7 per acre. Had a few pigs been carried and a slightly larger proportion of the farm put in crop with the same high yield this farm would probably have earned nearer to first place, because it was managed very economically. If household expenses had been included as a cost this farm would have ranked still higher, as returns from poultry more than paid the grocery account.

Much information was derived from the remaining farms. For example, the best returns from horses were obtained by P. V. Bailey; the highest cattle returns by J. C. Chamberlain; a useful method of saving expense and labour in the use of chaff-bags was shown by N. C. Powell, who built an endless belt for loading and tipping bags into the bins as they come off the chaff-cutter. Mr. Powell secured most points for buildings and plant. Mr. John Brooks secured the highest total for general points.

Conclusion.

The weather was unfavourable to the securing of the highest return, and to this extent the results were disappointing to some of the competitors, and are not typical. The competition committee propose to continue the competition, awarding certificates for the farms securing

the best percentage in returns relative to profit and loss each year, and awarding cups as funds accumulate each third year, on the basis of points for general headings as well as profit and loss. If large entries are obtained, so that similar types of farms are compared, very helpful management data will be obtained.

FACIAL DERMATITIS IN SHEEP IN NEW ZEALAND.

A PHOTOSENSITIVITY OF UNPIGMENTED SKIN.

Dr. C. S. M. Hopkirk, Officer in Charge, Veterinary Laboratory, Department of Agriculture, Wallaceville

Facial dermatitis, facial eczema, bighead, and sunburn are names given to a condition of sheep where the exposed unpigmented skin of sheep and cattle reacts to light, becoming severely burned. Two types are known, one being fairly prevalent in the South Island along the alpine foothills and back tussock-country, while the other has been seen mainly in the North Island during excessive autumn flushes of feed following prolonged dry summer spells.

Historical.

An œdema of the skin of sheep and the white areas of cattle has been known for a considerable time in connection with ingestion of St. John's wort (*Hypericum perforatum*), buckwheat (*Fagopyrum esculentum*), *Tribulus terrestris*, and certain medicagos and trefoils. Experimental trials, mainly in United States of America, Australia, and South Africa, showed the unpigmented skin only was subject to injury, there being elements in the plants mentioned which predisposed unpigmented skin to the harmful effect of ultra-violet rays. The injurious photosensitizing agent is a fluorescent body, and many fluorescent dyes and drugs have that action, examples being hæmatoporphyrin, quinine, eosin, rose Bengal, methylene blue, chlorophyll, phylloerythrin, &c.

While considerable work has been carried out in other countries on the photosensitivity due to St. John's wort the most valuable work on the whole question seems to be that performed in South Africa in connection with the disease "Geeldikkop," caused by ingestion of the plant Tribulus. In this work sheep with biliary fistulæ were used and the bile was obtained after feeding of the experimental plant. In Tribulus-feeding two factors have been found to work in combination, the one, a liver-upsetting factor, referred to as the icterogenic factor, and the photosensitizing factor which results from a breakdown of the chlorophyll-content of the plant.

In New Zealand facial dermatitis or facial eczema resembled in all its external symptoms " Geeldikkop " of South Africa. It is associated with a fast growth of pasture in the autumn following a condition of drought. The autumn of 1910, 1925, and 1926 were all of that description, and large numbers of sheep and some cattle became affected. On those occasions the condition was apparently not recognized as a photosensitivity.

A condition of scabby mouth due to a virus infection must not be confused with photosensitivity. In the former the ears are rarely, if ever, affected.

RECENT OUTBREAKS.

Of the two conditions, that in the South Island is suspected to result from ingestion of a species of Hypericum or St. John's wort. Several species of Hypericum have been found around lagoons and near damp areas on stations in the affected areas by Dr. H. H. Allan, Systematic Botanist to the Plant Research Station, and experimental work is centred round the plant at present. Owing to the courtesy of Mr. T. D. Burnett, M.P., and owner of Mount Cook Station in the Mackenzie Country, 560 acres of an affected block have recently been set aside and stocked with merinos especially to elucidate the problem in that area. Also, plants have been gathered for experimental feeding of stock at Wallaceville.

In the South the position has not been as serious as in the North, for if sheep were kept off affected blocks during December, January, and February very few cases of dermatitis occurred. Further, there have been no bad after-effects as in the photosensitivity of the North Island, for livers are in no way damaged. The North Island outbreaks have, however, always been of a serious nature. The outbreak of photosensitivity in the autumn of 1935 was very wide in its distribution, most areas being affected except for Hawke's Bay and the Wairarapa, where very few cases were seen. Cattle are noticeably affected in the Waikato and Bay of Plenty. As a rule, high hill-country was fairly safe, only comparatively few affected lambs and sheep being seen. Rich flats were particularly dangerous.

In the Gisborne area observations were made after the initial outbreak of the trouble. There were no premonitory signs, and many thousands of sheep became affected in the same week. The same applied broadly to other areas. Rainfall in the Poverty Bay district during the summer had been so short that the pasture of the whole coastal area was dried up and in most places eaten out by sheep and cattle. Inland on the back, high hill-country precipitation was sufficient to keep the grass green, though it remained short. On such pastures no photosensitivity occurred. Rain commenced to fall round Gisborne on 7th February and the weather remained warm, overcast, wet, and dull for some weeks thereafter. Actual sunshine was intermittent and of short duration for that season of the year. As a result of the rainfall and warmth there was a fast-growing flush of pasture, but, contrary to expectation, it is said that scouring in sheep and lambs was noticeably absent. Œdema of the head occurred first on 21st February, and many cases in the district were reported by 25th February. Several owners of rich flat land were heavy losers, one man having at least five hundred sheep and lambs affected, while hill-station owners may have noticed twenty to fifty animals affected. Ram and ewe lambs and all older sheep irrespective of sex were alike affected. True, black-faced sheep such as Suffolks were not affected, but Romneys and Southdowns were very susceptible.

Pastures on the flat contained clovers, trefoils, and the usual grasses such as rye-grass, crested dogstail, ratstail, cocksfoot, &c., and ordinary weeds. No plants which one could suspect of causing photosensitivity

were to be seen except burr clover, which grows well on the Gisborne Flats and is considered suspicious. However, burr clover is not common in other parts of the country where facial dermatitis was seen.

The sheep-owners of the district stated that the paddocks had been well eaten out by cattle during the dry weather. The rain brought a quick flush of feed which cattle were not able to control successfully. and which perforce had to be given to sheep of all classes. Where cattle had been able to control the feed very little or no œdema developed in sheep. Photosensitivity developed in some cases in two days after sheep were placed on luscious pastures, but usually it took a little longer for trouble to develop.

An interesting point was mentioned in the district: that sheep, and particularly lambs, had not fattened as well in the dry weather as is usually the case. This was borne out in meat-works figures, for weights were considerably less in the lambs being put through for the fat-lamb trade.

Ante-mortem Appearance.

The first suggestion of photosensitivity was a shaking of the head and general restlessness. The ears quickly became œdematous and drooped, this being followed by a puffing of the eyelids, face, tongue, lips, and submaxillary space, and even, in some cases, the legs. In those sheep in which the wool was inclined to be open along the back, the skin of the back swelled, thus ruining the pelt. The temperature rose to as high as 107° F. Sheep actively sought shade and disliked being driven out into brighter light. Irritation of the skin caused the sheep to rub the skin of the ears, eyes, and lips on fences, ground, &c., which caused severe abrasion with subsequent infection and scab-formation. Ophthalmia developed and ulceration of the cornea was not uncommon from injury, while nostrils were frequently almost entirely blocked by scabs and catarrh. All mucosæ showed an icteric condition ranging from light, muddy colour to a deep yellow. Urine was dark and frothy. Black pigmented areas of skin remained normal. Sheep unable to obtain shade either travelled round the fence-line in an endeavour to break through, or they banded together with heads hidden beneath the bellies of other sheep. Sensitivity to all light was most marked, rest being obtained by affected animals only in dark sheds. When shade was unobtainable the skin-injury was intense and abrasion became so severe that it was necessary to slaughter the animal to put it out of pain. If sheep were placed in wool-sheds at the first indication of irritation, then face-lesions quickly recovered.

Post-mortem Appearance.

Incision in the abrased areas, whether head, back, or legs, showed an intense œdema of the subcutaneous tissue. The fluid was straw-coloured or even more deeply pigmented. Lungs, heart, spleen, alimentary canal, and kidneys were all normal, though there was some œdema to be noted in the pelvic fat of the kidney. Blood clotted normally, but the serum was extremely yellow. Urine was dark but not port-coloured, as in co-called "enzootic icterus."

The liver was the chief seat of damage. In all cases damage ranged from simple cholangeitis (inflammation of bile-ducts) to a state of deeply bile-stained necrosis of liver-cells. In acute cases of the disease the

liver was yellow-ochre coloured. The liver showed in many cases a mottling of the surface, the lighter areas appearing to follow the course of certain veins. The gall bladder was distended with a dark-green bile, and lymph channels leading from the liver contained a greenish lymph. The most interesting point to be seen in all livers was the thickening of the main bile-ducts leading from the lobes, particularly the left lobe. In normal sheep the bile-ducts are difficult to pick up, but in sheep with dermatitis this thickening was marked and the duct stood out as a white cord very similar to chronic infestation with liver fluke. The duct was found to be partially blocked with a brown, amorphous, inspissated mass of debris. Where the cholangeitis was of some standing the liver was hard and cirrhotic. With the partial damming back of bile, jaundice occurred and bile stained the body tissues as well as the liver-cells. Toxic changes in the liver, shown by mottling, probably occurred as a result of the inability of damaged liver-cells to deal with toxic products brought in the blood-stream from the alimentary canal. The main bile-duct to the duodenum was at all times patent. Sections of liver examined under the microscope showed a very great increase in bile-capillaries. In some cases cirrhosis was commencing in the liver in the supporting connective tissue about the bile-capillaries, and in quite a number of cases cirrhosis was becoming of a perilobular type and gave promise of going further. There was no sign of hæmorrhagic areas in livers from animals suffering from photosensitivity such as would have been seen in acute ragwort poisoning.

Discussion.

Two facts of importance were evident in the initial survey of the disease, the one photosensitivity, the other liver-damage. Both required explanation. It would seem that photosensitivity developed only where there was liver-dämage, but liver-damage did not necessarily produce photosensitivity. Liver-efficiency tests with rose Bengal showed definite damage in the liver of the living subject.

A special inquiry was therefore made into the state of sheep and lambs' livers in the Gisborne area. At the Kaiti Freezing-works many thousands of livers were observed, and whenever necessary the holding from which the sheep came, together with information concerning the sheep, was obtained. A large number of livers were being discarded for hardness and mottling. This state of affairs had commenced early in January and was quite unusual. Although only a percentage of sheep with affected livers were photosensitive, animals without liver-lesions were not affected. In one or two lines where all or practically all livers were normal, no cases of head œdema had been seen and such lines came from green hill-country. Although much thought has been given to it, the reason for liver-damage and the exact time at which livers became damaged, whether before or after the flush of grass, is unknown and is a matter for further research. Several theories suggest themselves, but they lack proof at present. Once the liver became damaged, however, the flush pasture could readily cause the photosensitivity. Much work has been carried out in South Africa on chlorophyll of plants, and it has been shown that the green colouring-matter is broken down in the rumen to form a fluorescent body—phylloerythrin—some of which is normally absorbed and excreted by the liver. With damming-back of bile into the blood-stream this coloured body makes the skin

sensitive to light. Dr. Margeurite Henrici, also working in South Africa, has shown that chlorophyll of plants alters considerably not only from dry to wet season, but also from day to day and hour to hour. It is high in the young green leaf, but low in the dried or wilted plant. Sunlight during the day decreases it, and resynthesis occurs during the night. On dull days, as Gisborne had, the chlorophyll-content remained on a high level. Everything was therefore in an optimum condition for photosensitivity to develop provided the livers were damaged.

After-effects.

A further important aspect of the photosensitivity of the North Island was the very serious after-effect. The livers were so badly damaged that sheep were slow in recovering their energy and condition. Many died within a few weeks, others lingered on and died later. Ewes failed to conceive, and lambing percentages amongst affected ewes were very low. If sheep fattened and were sent to the meat-works the livers were found to be extremely badly damaged. The left lobe was completely atrophied, while the remainder of the liver was bulbous from regeneration of liver-cells. So badly damaged was the liver that affected sheep could never be entirely normal. Livers appear somewhat similar to those caused by severe ragwort-poisoning, but fortunately the two conditions can be differentiated. The damage appeared to have originated from occlusion of bile-ducts and not from blockage of blood - vessels in the liver. At present as a working hypothesis one must assume that liver-cells were slightly damaged by poison absorbed from the bowel during the dry weather. They were further intensely damaged by the damming-back of bile through blockage of bile-ducts.

Preventive Measures.

Advice regarding prevention of liver-damage with our present knowledge is impossible, but probably if green feed were available during the dry summer it would help considerably. Such a supply of green feed, however, would be almost impossible for most farmers to obtain without irrigation. Control of feed when conditions were known to be conducive to photosensitivity would certainly assist. This was seen in several cases where owners had kept paddocks eaten down with cattle. Should climatic conditions recur within the next few years owners should at once close up the majority of paddocks and heavily stock a few to prevent excessive growth. As an alternative, and where possible, the mower could be kept going to level feed off. One other practice which was adopted successfully on one farm in the Manawatu was to put out hay-racks for sheep in a small paddock and keep the animals entirely on hay and water during the first flush. They can then be slowly broken in to green feed.

Treatment.

Stock must be watched carefully with a view to early mustering if swollen ears appear. Driving must be carried out slowly in the cool of the day. Affected sheep require to be placed in dark sheds at once and kept there, getting no green food for two or three days. They should be supplied with water and a light

feed of hay. Badly burned sheep should be slaughtered, for they never do well afterwards. All affected sheep should be given Epsom salts, Glauber salts, calomel, or other purgative to stimulate the bowel and liver. Faces may be treated with a black ointment or with Stockholm tar, so as to cover the skin with a black pigment to keep off light. Sheep kept in sheds should be first of all let out at night for a few hours grazing, then let out in the daytime, but with the shed left open so that if they still feel the sun they may return to the shed at will. Such convalescent sheep should not be returned to a flush of grass or they may readily suffer a relapse.

SUMMARY.

Facial dermatitis is known in both North and South Islands. In the South it is believed to be due to a plant probably a species of Hypericum, while in the North the condition occurs under definite climatic conditions.

Two factors operate in the latter case—the one liver-damage, the true cause of which is unknown ; and the other, absorption of a fluorescent material from the breakdown of chlorophyll, which sensitizes the unpigmented skin to light. Prognosis is bad in such cases, alleviative treatment being to give purgatives and to keep in the dark away from sunlight until they have recovered.

LEMON-CURING FOR SMALL GROWERS.

W. K. DALLAS, Citriculturist.

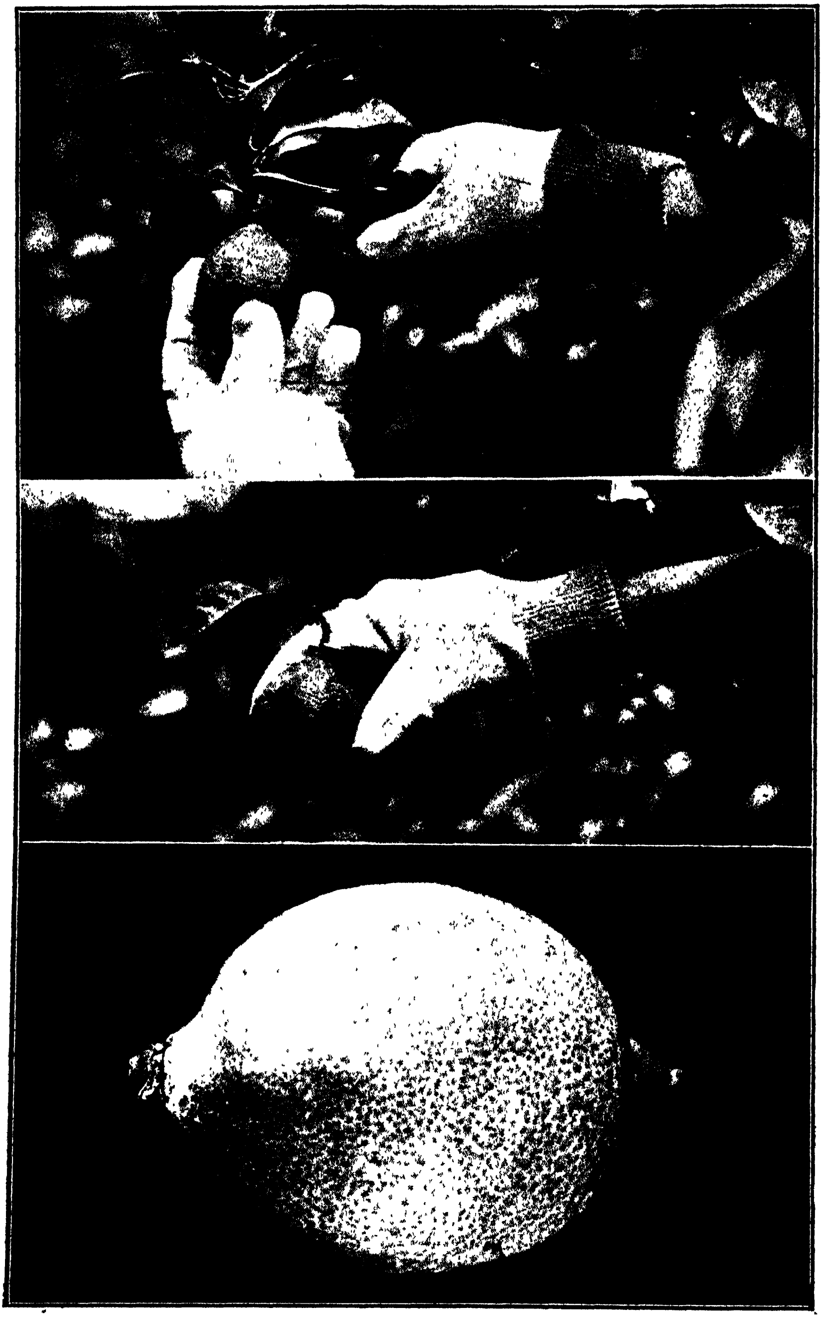
THESE notes have been prepared for the guidance of persons who have but a few lemon-trees growing on the property which they are occupying.

Lemons carefully handled and gathered from the tree at the right stage of maturity may be successfully cured or conditioned, and then stored for several months without deterioration. By suitable treatment their keeping and edible qualities and appearance are improved.

In the process of curing, lemons are submitted to a mild dehydration treatment, which causes the skin to become thinner and tougher. When properly cured the rind of the lemon should be smooth and soft, and the colour of the fruit changed from green to yellow.

To obtain the best results from curing, the lemons should be carefully cut from the tree, preferably with sharp clippers with rounded nose, when they have reached a size of approximately 2½ in. in diameter, but are still green or silver-green in colour. The stalk should be cut just beyond a mature bud and about 1½ in. from the fruit, then double-clipped level with the button, for unless this is done the protruding stem is liable to damage fruits with which it comes in contact. Every care should be taken to avoid scratching the lemons with the finger-nails or other means, and damaging the rind by bruising. Injured parts readily decay.

After picking, the fruit should be placed in trays or shallow boxes in a shaded, airy position and allowed to remain for several days to permit the excess moisture to exude from the rind. If not sweated in this way the lemons will tend to become unduly damp in storage and thus be more liable to infection by moulds.



PICKING LEMONS.

Top, first clipping; centre, second clipping; bottom, lemon correctly clipped.

The dipping of the lemons in water heated to 110° F., containing borax at the rate of 4 lb. to 5 gallons, for a period of four minutes, before placing them in storage, is practised and recommended to reduce the danger of the fruit becoming affected with blue or green moulds.

The fruit should then be put in a box with one-piece sides or in trays, covered with a piece of canvas or other suitable material to prevent excessive wilt of the fruit, and stored in a darkened room in which the relative humidity and temperature should not be allowed to fall too low. A relative humidity of about 75 per cent. and a temperature of between 40° and 65° F. is suitable. If the atmosphere of the storeroom is considered to be too dry, the humidity can be increased by sprinkling water on the floor as occasion demands. According to the temperature maintained, the curing process should be completed in from six to ten weeks. If it is desired to speed up the colouring, a higher temperature and humidity may be maintained about the fruit by covering the boxes entirely with canvas or sacks when it is placed in the store; or the temperature may be increased by the use of a paraffin or other heater. The fruit should be inspected periodically, and all lemons which show signs of decay carefully removed from the box and burnt.

Another method of curing the fruit is to store the lemons in clean, slightly damp sand or sawdust in one-piece-sided boxes lined with paper. A layer of about 2 in. deep of the material to be used is first laid down, and then a single layer of lemons is placed on this so that no two fruits are touching. The lemons are then covered with at least 1 in. of the material which is being used to store them, and then another layer of fruit, and so on, until the box is full.

Briefly, the recommendations are—

(1) Carefully clip the fruit from the trees when it has reached the size of 2¼ in. to 2½ in. in diameter and while green or silver-green in appearance—green lemons keep longer than those ripened on the tree.

(2) Handle the fruit carefully to avoid causing injury to the skin of the fruit.

It is through injuries such as punctures, scratches, and bruises that rot fungi gain access to the tissues.

(3) Place fruit in shaded airy situation for four days to sweat.

(4) Then dip fruit for period of four minutes in borax solution (4 lb. borax to each 5 gallons water) heated to 110° F. and allow fruit to dry.

(5) Place fruit—

(*a*) In a close-sided box or box lined with paper or in trays and cover with canvas; or

(*b*) Between successive layers of slightly damp sand; or

(*c*) Between successive layers of slightly damp sawdust.

(6) Examine fruit fortnightly for purpose of removing mould-infected fruits, which should be burnt.

(7) Maintain as far as practicable a temperature of between 45° and 65° F., and a relative humidity of approximately 75°.

(8) Curing process will take from six to ten weeks, according to the conditions under which the lemons have been produced.

Green lemons usually take longer to condition than silver-green lemons.

(9) The storeroom should be darkened, kept well ventilated, and draughts should be avoided.

MANUKA-CONTROL IN OTAGO.

J. M. SMITH, Fields Superintendent, Department of Agriculture, Dunedin.

DURING recent years manuka has made serious inroads on to some of the better pastoral country of Otago, and at the present time the threatened invasion by this scrub of farming lands is serious. While manuka generally is looked on as a weed of poor land, like many other weeds, if given the opportunity, it rapidly spreads on to adjoining good land, and this is what is taking place. (Fig. 1.) The size of many holdings where manuka has a hold, together with the value of the land and the present financial returns for produce, means that some fairly cheap method of control must be practised to make such control economically sound. Undoubtedly the cutting of the scrub, prior to burning and sowing, is the most satisfactory way of dealing with manuka, but when the cutting alone will involve an expenditure of between £1 10s. and £3 an acre (dependent upon the denseness of the scrub) it will be seen immediately that the cost of this system over much of the pastoral land is prohibitive. It should be recognized clearly that there is much land in Otago of such a low standard of fertility, and at present in dense manuka, that it cannot profitably be brought back to a grazing state, but the treatment of such land by way of afforestation is beyond the scope of this paper. It will thus be seen that some cheap yet efficient method of burning the standing scrub, to be followed by the sowing of a cheap yet productive grass-mixture, must be the line of action to be followed. Promiscuous burning, which has been practised largely in the past, is not satisfactory, in that a fringe of green scrub on the outer area is left unburnt and the spread goes on unhindered. The prevention of the spread is actually of as much importance as the cleaning-up of the dense centre of the area. (Fig. 2.)

With a view to determining whether some cheap yet efficient method could be followed, a block of standing manuka where the scrub was some 8 ft. to 10 ft. in height was taken over on the property of Mr. R. S. Thompson, Wetherstones, Lawrence, in 1930. This block was divided into three areas of sufficient size to warrant the costs and results being of a practical nature. Area No. 1 was completely cut and subsequently burnt and sown. (Fig. 3.) Area No. 2 was fringed—*i.e.*, the scrub was cut round the block to a depth of 12 ft. and was subsequently burnt and sown. Area No. 3 was tracked—*i.e.*, every 20 yards a track 12 ft. wide was cut through the standing scrub. The cutting was done during the summer and the area was fired on 13th May. Very favourable conditions were experienced for burning, and the results on all blocks were exceptionally good.

As a result of this experimental work together with the experience of settlers who are handling the problem efficiently, and, it would seem, economically, it is felt that the following system, with variations to suit local conditions or certain seasons, should prove satisfactory.

The manuka should be burnt standing after having been fringed to a depth of several yards. This fringing should consist of slashing all scattered bushes on the outside ring of the standing block, together with a reasonable belt of the standing manuka. Solid manuka can be burnt without fringing, but as a rule such a burn leaves a ring of standing scrub

round the burn, and this ring continues seeding and so causes new infestations of seed each season. Fringing also allows the commencement of a fierce fire, which carries on with vigour through the standing scrub. The actual time of burning depends largely upon local conditions, but

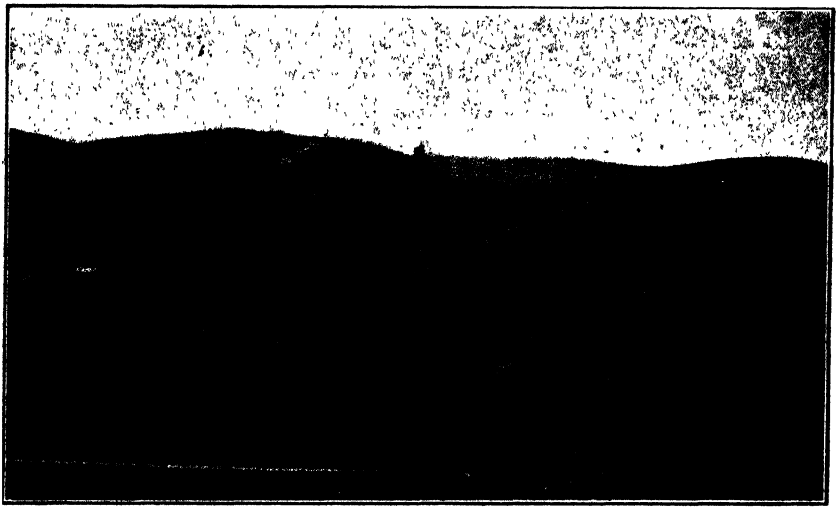


FIG. 1. SHOWING THE GRADUAL SPREAD OF MANUKA ON GOOD GRAZING COUNTRY.

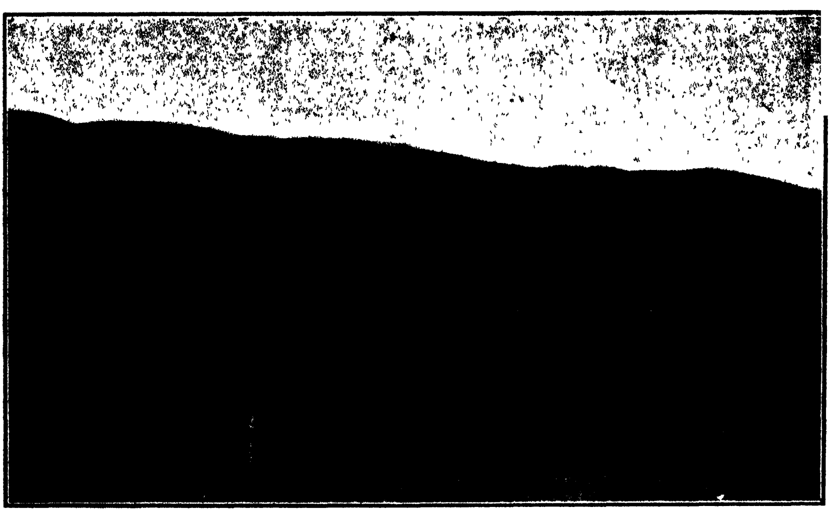


FIG. 2. THE RESULT OF INDISCRIMINATE BURNING, SHOWING THE GREEN FRINGES UNAFFECTED BY FIRE.

burning should be carried out at a time when the best burn can be obtained and when the chances of a good strike of grass are best. It should be emphasized, however, that there may be only one or two opportunities to get a first-class burn each season, and these opportunities

should be waited for. A good hot burn, when the vegetation beneath the standing scrub is dry right to the ground, results in a complete kill of the standing scrub, the preparation of an excellent seed-bed in the ash, and the destruction of much seed both on the ground and on the manuka itself. In tussock country the weight of evidence is in favour of spring burning of manuka.

It is considered by some to be an advantage to cut belts through the standing scrub, as such procedure ensures a better burn by livening up the fire at 20 yard intervals, facilitates sowing ; and enables stock to move more freely over the burn subsequently. The cutting of such belts, however, greatly increases the cost, and unless the benefits are likely to be extensive this procedure can hardly be deemed necessary or economical. In the experiment under review the tracking was of no advantage.

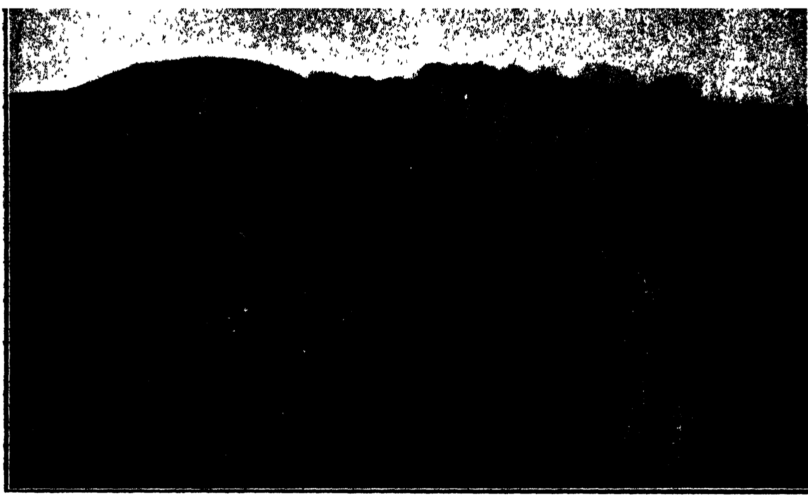


FIG. 3. AREA NO. 1, ON LEFT, ALL SCRUB CUT ; AREA NO. 2, ON RIGHT, FRINGED.

To be noted almost entire absence of second growth on area No. 1 ; area No. 2 fenced to allow of growth to carry secondary burn.

The surface-sowing of a suitable seed-mixture immediately after the ash has cooled is strongly recommended. In some few cases there may be sufficient brown-top and danthonia present prior to burning to warrant the elimination of any sowing, but if the standing manuka has been there for any length of time it is hardly likely that there is sufficient grass present to carry on. There may be a certain number of suitable plants present, however, in which case the sowing could be at a less rate than where the ground is devoid of any pasture plants. Local conditions undoubtedly should be a guide in connection with the grass-mixture to sow, but in general brown-top and danthonia should be the main species. This surface-sowing is likely to constitute the main cost in connection with this method of manuka-control, and consequently requires to be closely watched. Its total neglect, however, must be avoided, for without the application of seed, where the area is devoid of pasture plants, only such growth as bidi-bidi, &c., will follow the burn, and as far as productive value is concerned the area might as well

be still in scrub. For general purposes the following mixture, expressed in pounds to the acre, might be adopted: Brown-top, 6; *Danthonia pilosa*, 4; crested dogstail, 3; Chewings fescue, 2; *Lotus major*, 1; white clover, 2.

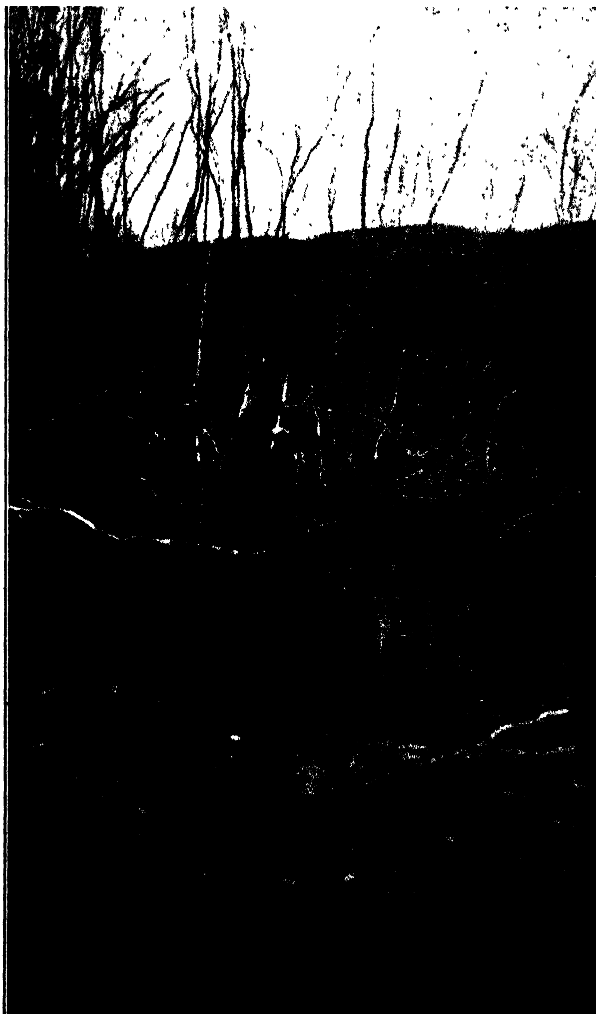


FIG. 4. SHOWING AREA FENCED AND UNGRAZED PRIOR TO THE SECONDARY BURN.

The growth is principally manuka, but with sufficient brown-top, &c., through it to ensure a fierce "carrying" fire once the brown-top, &c., has dried.

Perennial rye-grass and cocksfoot might be included in a special mixture for better-class land and for gully-bottoms, but for general application their inclusion can hardly be recommended. This phase, however, leaves much room for experimental work. The main feature

of the mixture is the brown-top-danthonia-lotus association, which association will stand up to, and probably improve, under subsequent burnings which will undoubtedly be necessary.

If the original burn was a good one and the strike of grass satisfactory it will probably be several years before there will be any second growth to worry about. When this growth does appear it will be necessary to deal with this by a secondary burn. To carry a satisfactory fire at this stage it is obvious that there must exist a fair quantity of dry roughage, and this will only be secured by spelling. (Fig. 4.) Possibly, however, sufficient roughage will be secured by the falling sticks making hard grazing impossible. After four or five years the standing burnt manuka begins to collapse, and this may form a protective covering by which hard grazing of the pasture by stock is prevented, and in the spring of the year a fire of sufficient fierceness may be obtained to deal with the second growth. On the other hand, it may be necessary (and probably would prove most beneficial in the end) to spell the area for a season to secure this roughage to carry the fire. This would entail the fencing of the area into blocks that can be conveniently spared for a complete season. Naturally this would increase the cost somewhat, but unless this can be done, and the second growth thus dealt with, it is feared that the area may rapidly revert to its original manuka position. No further seeding should be necessary following this second fire, although it may offer an opportunity to sow seed on patches and thus build up any weak spots.

The whole of the handling of this country hinges round the cost, for if the cost is too great it becomes beyond the means of the average settler, and it is impossible to get anything done. To arrive at actual costs is extremely difficult. To begin with, the area to be fringed per acre depends upon the density of the manuka and the area over which a dense block occurs. For instance, if the blocks are small the fringing per acre is larger than where the blocks are large. For the actual area fringed the cost is probably about £2 per acre, and if it is necessary to fringe 1 acre in ten this brings the cost to 4s. per acre of the block to be treated. In many cases with big blocks the cost should not be more than 1s. to 2s. per acre. The cost of the grass-seed mixture also varies, but the cost of the mixture quoted, at current rates, is about 30s. per acre. To this must be added any fencing-costs that are incurred, together with the clearing of the fence-lines prior to the second burn.

SUMMARY.

(1) Much of the grazing country of Otago can be economically held, and even brought back, from manuka invasion.

(2) Complete cutting, burning, and sowing, while giving the best results, probably proves too costly in most instances.

(3) Fringing to a depth of several yards, and burning at an opportune period, to be followed by the sowing of a suitable grass-mixture will prove satisfactory, provided

(4) That this is followed by spelling to allow satisfactory secondary burns.

Acknowledgment is made to various Fields Division officers, past and present, who were responsible for the experiment on manuka-control, and to Mr. R. S. Thompson, Lawrence, for his co-operation.

PARASITIC GASTRO-ENTERITIS OF LAMBS AND HOGGETS.

WARNING TO FARMERS.

C. S. M. HOPKIRK, Veterinary Laboratory, Department of Agriculture, Wallaceville.

THE present season, with its excessive growth of grass, abnormal rainfall and warmth, is an excellent one for parasitic infestation of young sheep. Throughout the country lambs are not, as a general rule, thriving because of the coarse feed conditions, and such lambs readily become infested with stomach and intestinal worms.

It is therefore advisable for farmers to commence the control of parasites at once. This is best done—

(1) By quick changes of lambs every few days on to fresh pasture :
(2) By thorough eating-down with cattle of those paddocks best suited to lambs before changing lambs to them :
(3) By periodic drenching of lambs.

All three methods should be employed in order to combat parasites successfully, but the third method is most essential.

Recently a very useful parasitic drench based on a knowledge of physiology of the sheep has been advocated in other countries and has been given a trial at the Veterinary Laboratory, Wallaceville, on lambs and two-tooths. Results in two-tooths have been exceptionally good. The drench consists of 1 lb. bluestone dissolved in 5 gallons of water, and, after the bluestone is thoroughly dissolved, a 1 lb. tin of Black Leaf 40 is added.

Drenching at ten to fourteen day intervals of all young sheep and lambs should be kept up from now till the danger period has been passed. Dosage is ½ oz. to lambs and 1 oz. to young sheep.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 12th December, 1935, to 31st December, 1935, include the following of agricultural interest :—

No. 72911 : Manure-distributor ; E. C Houchen No 73276 Production of milk-powder ; J. B. M. Knutsen. No. 73471 . Preparing whey concentrates ; Kraft-Phenix Cheese Corporation. No 73478 : Tool for ring-barking trees ; Commissioner of Forest Lands. No 73649 : Sheep-shearing machine ; Cooper Engineering Co., Ltd No 73736 : Manure-distributor , E V. Twose. No. 74502 : Preserving fruit , T. A. Robertson. No 74557 · Drying timber ; W. E. Saunders. No. 73112 · Separator; Ramesohl and Schmidt No 73220 : Ringing animals ; R. Du Pontet. No. 73744 : Cream-cooler , A. M Campbell. No. 73859 : Gate-latch ; J. Johns. No. 74089 . Plough , T and W. G. Yardley. No. 74216 : Curing cheese ; the A A. Ayer Co , Ltd. No. 74342 : Removing wool from skin , I. W. Archibald No 74555 Feed-trough ; D. F. J. Hopkins. No. 74577 : Eradication of lung-worm , C B Bazley. No. 74628; Shearing hides; M. M. and A. van Osselaer. No. 74662: Egg-grading ; Kraft Egg Machine Co. No. 74722 : Sheep-drenching device ; Hart and Co. Pty., Ltd. No. 74781 : Harrow ; J. H. Gibbs. No. 74840 : Branding-device ; R. E. Starr, M. J. Plomley, and E. F. Plomley. No 74913 : Fencing-standard socket ; P. C. Scott. No. 74974 : Horse-shoe ; A. G. Craft. No. 75003 : Barbed wire ; H. A. Abbott.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

SEASONAL NOTES.

THE FARM.

Pasture Establishment.

EXCEPT in districts subject to relatively early heavy frosts, autumn sowing of seed for the establishment of permanent pastures rightly is much followed as the result of field experience. Generally March sowing gives best results, because frequently in March the soil possesses both the warmth and the moisture which beget the rapid and strong establishment of seedlings. If the sowing is deferred until late autumn or early winter there develops much likelihood of poor establishment, particularly of clovers—indeed a substantial proportion of the indifferent results that come under notice are due primarily to too late sowing at this season. In occasional favourable seasons or circumstances sowings that would be too late under ordinary conditions are attended with success. These are remembered, whereas the more numerous instances of failures following too late sowing are overlooked. Indeed, it seems likely that many cases of unsatisfactory results due to too late sowing are attributed to other causes; for instance the owner seldom assigns late sowing as the cause of unthrifty young pastures —he is more inclined to attach the blame to such a cause as poor seed— but actually many of the unthrifty young pastures that are noted originate in poor "strikes" of the clovers which in their turn arise from unduly late sowing. It is of practical moment that the rye-grasses and red clovers, generally speaking, establish satisfactorily at lower temperatures than other species commonly used and so safely can be sown later in the autumn or earlier in the spring. On the other hand, white clover, cocksfoot, and timothy require for successful establishment more favourable conditions than rye-grass and red clover. Hence a sowing which may seem successful in its early stages because of the appearance of the rye-grass and red clover may eventually prove unsatisfactory because the expected development of white clover, cocksfoot, &c., does not take place. Further, most species, if sown too late in the year, although germinating, do not establish to the best advantage before the advent of winter because of the initial stunting and probably never develop into as robust plants as would have been produced had growth been vigorous from the outset.

Although satisfactory results have been obtained widely from surface sowing it is desirable when practicable to cover all seeds to minimize the effect of dry conditions immediately following conditions which have brought about germination. The general aim of covering practices should be to cover such seeds as rye-grasses, cocksfoot, and clovers to depths of about ½ in. and not to greater depths than about 1 in., and finer seeds generally to less depths. In soils containing large and coarse lumps proper covering is impossible, while on the other hand too fine and powdery a condition of the soil hinders proper covering, successful "strikes" commonly are obtained when the surface is slightly rough, as is the case when it is composed largely of lumps of from ¼ in. to ¾ in. in diameter.

The necessity of a good tilth and firmness of the seed-bed which has been dealt with in these notes during recent months can scarcely be overemphasized. The desirable degree of firmness which is obtained most satisfactorily and economically as the result of adequate preparatory cultivation greatly assists in bringing about an even sowing and is specially necessary to ensure that seeds start well into growth. When the seed-bed is sufficiently fine and firm pasture seeds usually may be covered effectively by a stroke of the tine harrows. If the seed-bed is loose and dry, the use of

the Cambridge roller after sowing is usually advisable ; but if there is probability of heavy downpours of rain it is frequently well to finish with the harrows instead of the roller, especially when the soil contains an appreciable amount of fine silt which readily leads to the formation of caked soil-surfaces after beating rains. The sowing of other crops such as oats with pasture seed is sometimes favoured because of the belief that the companion crop will protect the pasture seedlings. Such crops, which are called cover or nurse crops, generally are of little or no value as protection and readily may cause injury by depriving the pasture seedlings of direct sunlight and also possibly of adequate moisture. Such injury may be minimized if the companion crop is sown thinly and not allowed to mature, but even under such circumstances the possibility of injurious shading is not eliminated completely, and hence the use of companion crops generally is not recommended. Exceptional cases which warrant the use of cover crops may arise in exposed situations, and in such cases barley or white oats may suitably be used—usually Algerian oats are not suitable because of their relatively slow growth in the early stages, when shelter might be needed by the pasture seedlings.

The Composition of Seed-mixtures.

A primary objective in grass-farming is to obtain the most even possible supply of feed from season to season throughout the year. At the same time uniformity in the amount of feed available from one season to the other must not be secured at too great a sacrifice in the total yield of feed. A fundamental matter in framing pasture seed-mixtures fitted to give the greatest possible evenness in the seasonal supply of feed is the well-known fact that different pasture-species in their growths respond differently to particular conditions. For instance, rye-grass and dogstail and No. 1 white clover grow more freely than cocksfoot, timothy, and Montgomery red clover early in the season , in most of the milder parts of the North Island paspalum is active in mid-summer and practically dormant in winter, while subterranean clover tends to be dormant while paspalum is most active and most active when paspalum is least active in growth

A moot question is how should this knowledge of the different growth-behaviour of different species be used. Clearly, by including in the pastures on a farm a series of species such as rye-grass, white clover, cocksfoot, and red clover, it is possible to obtain a more even supply of feed throughout the year than would result from the use of fewer species. The question of practical moment is whether the species should all be sown together so that each pasture becomes a mixture of considerable amounts of all the species or whether different species should not be dominant in different fields throughout the farm so that for practical purposes there is a range of species on the farm as a whole rather than on each field of pasture on the farm This question was discussed at some length in these notes in February, 1935, where it was stated that " Investigations and field experience both in New Zealand and overseas suggest the advisability of employing more freely still more simple mixtures designed to cater especially for a particular season and also usually to fill a particular need." This view is quoted because in the interval further evidence has accumulated in support of it. An outstanding instance of the successful application of this conception is provided in the numerous pastures, in which subterranean clover is dominant, which are dotted throughout the North Island at least. Similarly, in the warmer districts, marked success has attended pastures in which paspalum is dominant in the summer. There seems every reason to expect that similar success would be associated with other special pastures. For instance, a special pasture with cocksfoot and Montgomery red clover as its dominant constituents contains, under lenient spring grazing, promise of a better supply of feed late in the season

than would result were the cocksfoot and Montgomery red clover used on several fields subject to normal grazing and containing the customary proportions of other pasture species.

Under the methods of grazing which to-day are widely carried out certain valuable plants often are not employed to the fullest advantage. The needs of cocksfoot and rye-grass well illustrate this: under moderate to high fertility, if the grazing is relatively severe and continuous, perennial rye-grass readily outyields cocksfoot, whereas under the same type of fertility, if the grazing is sufficiently lenient, cocksfoot outyields the rye-grass. Further, as a rule, plants defoliated at the critical stage of early active growth suffer more severely than plants similarly defoliated when beyond the critical stage of early growth. Hence, when rye-grass and cocksfoot both are important constituents of a sward, considerable difficulty arises in the planning of grazing which will utilize the rye-grass in the best manner and at the same time avoid injurious defoliation of the cocksfoot which is likely to be at the critical stage of early growth when the rye-grass is already beyond that stage.

The use of special pastures at times would allow both plants to be utilized with greater effect. By having a sward in which rye-grass is dominant and another in which cocksfoot is dominant it would be possible to adapt the time and manner of grazing each sward to its specific needs and so to avoid any weakening of pasture plants by unsuitable grazing. Hence special pastures properly used should mean not only a more even supply of feed throughout the year, but also an increased supply of feed. From the above statements it follows that a basic aim of special pastures is to associate as dominant constituents species each of which may be used effectively without any injurious influence upon the others. This may be done in one of two contrasting ways. Firstly, it may be done by associating plants which coincide in their season of growth; these plants can be kept strong by being allowed to go unchecked by defoliation at the critical time of early active growth. Suitable companion plants for this purpose are cocksfoot and red clover. Secondly, it may be done by associating plants which contrast in their season of growth so that one is naturally dormant when the other is most active. The splendid results obtained in milder districts by growing together paspalum and subterranean clover illustrate this and are due to the fact that the plants do not interfere with each other in their growth.

The alternative to seed-mixtures designed to give special pastures of the types just discussed is to use seed-mixtures of the kind which have been used extensively in recent years with relatively good results. These mixtures are designed to give general-purpose pastures, and the nature of their constitution is indicated by the following mixtures which have been used successfully (all amounts being per acre):—

For permanent pastures a mixture which is suitable for use over wide areas in both North and South Islands: True perennial rye-grass, 20 lb. to 25 lb., New Zealand cocksfoot, 10 lb. to 15 lb.; crested dogstail, 3 lb.; timothy, 3 lb., New Zealand white clover, 2 lb.; red clover, 3 lb.

The smaller amount of rye-grass in this mixture is advisable when the summer rainfall is below that needed for good results with rye-grass, as under typical Canterbury and similar conditions; and under these conditions the larger amount of cocksfoot is advisable, as it also is when it would not be profitable to raise the fertility of the land up to rye-grass-fertility requirements by top-dressing.

The following modifications to the mixture are likely to be advisable under the conditions specified:—

(1) On land which is of naturally high fertility and on which the permanence and good growth of rye-grass all the year round is assured, a mixture consisting of 40 lb. of perennial rye-grass and 3 lb. of white clover may be used, the other species being omitted. There is only a limited area of such land.

(2) In many northern districts of the North Island paspalum at the rate of 6 lb. to 8 lb. an acre may advantageously replace cocksfoot.

(3) *Poa trivialis* at the rate of 2 lb. an acre should be included on high-class country which is damp in the winter.

(4) Meadow foxtail is a grass of high value on fertile swamps too wet in winter for success with rye-grass, and 6 lb. an acre should be included for such conditions. But if it is at all practicable to drain the land and thereby make it suitable for rye-grass, this should be done and rye-grass sown.

(5) Strawberry clover at the rate of 1 lb. an acre may well be substituted for white clover on land too wet for the latter, and its use is also advisable for salty marshy conditions.

For temporary pastures of one or two years' duration a mixture which may be expected to give good results widely is: Italian rye-grass, 25 lb. to 30 lb.; red clover 6 lb.: total, 31 lb. to 36 lb. per acre. The temporary pastures that such a mixture would provide are of considerable value both as a means of spelling land which has been impoverished by cultivation and as a means of weakening or eliminating weeds, such as blackberry or tall fescue, prior to the sowing of a permanent pasture.

For short rotation pastures which are intended to have a life of two to three years the mixture recommended is as follows: Italian rye-grass, 15 lb.; perennial rye-grass, 15 lb.; red clover, 4 lb; white clover, 2 lb.: total, 36 lb. per acre. Short-rotation pastures are employed mainly on farms on which—largely because of climatic conditions—arable crops instead of pastures are the dominant feature.

Detailed information about seed-mixtures for specific purposes and conditions is available from local officers of the Fields Division.

Two points about seed-mixtures which are of general moment are:—

(1) Since the introduction of seed certification several years ago each year has provided additional conclusive evidence that the use of certified seed is economically well worth while. It is now widely recognized that certified perennial rye-grass should be used whenever the use of perennial rye-grass is warranted. Probably a fact not so widely recognized is that the great difference between good and poor strains of perennial rye-grass is paralleled by the difference between good and bad strains of white clover.

(2) All lines of seed, including certified seed, should be purchased on the basis of their value, which is determined to a substantial extent by the germination-capacity. The appearance of seed is far from a reliable indication of its germination-capacity.

Management of Established Pastures.

The valuable role of top-dressing at this season as a means of bringing about increased production of leafy feed was discussed in these notes last month. Of the several measures which may be employed to increase the supply of leafy feed which is apt to be in unduly scant supply, top-dressing, especially with phosphates and, in suitable districts, basic slag, deserves pride of place. Another practice which assists in bringing about leafiness in pastures is "topping," which consists not of close mowing, but of light mowing which removes the flower-heads.

Grass-harrowing as soon as good rains occur is another practice which at this season fosters production of leafy feed on pastures on which droppings have accumulated during the usual dry summer spell. The main objective, which is the distribution of droppings, is achieved most effectively by two strokes of the harrows, one at right angles to the other.

Work with Special Crops.

The sowing of catch crops in late summer is at times well worth consideration. Land having grown such crops as oats, wheat, maize, millet, or soft turnips may be ploughed immediately these crops are removed and

then sown without delay in temporary pasture (for which a seed-mixture has been given in a preceding paragraph) or oats or barley. Black skinless barley, at the rate of about 2½ bushels an acre, may be sown for earliest possible use. Algerian oats are useful for providing later feed. With all these crops it is generally profitable to apply, at the time of sowing, superphosphate at the rate of 1 cwt. to 3 cwt. an acre according to the natural fertility of the land. In preparing the land for catch crops it is not necessary to reduce the surface soil to a fine condition ; indeed, the presence of fine clods at times proves a distinct advantage. The clods eliminate the caking of the surface, which may develop in a fine surface layer of soil under beating rain, and eventually they are broken up by natural weathering. If the land to be sown in such crops is so hard as to make satisfactory skim-ploughing impracticable, then cultivation with disks set with plenty of cut frequently serves suitably as an alternative to the skim-ploughing. Such crops, and particularly the temporary pasture, should be sown with as little delay as possible. These crops serve not only for sheep and cattle, but also particularly well for pigs provided they are consumed by the pigs when in a leafy stage They become available for pigs when the amount of feed available from the pastures is undesirably scant. Grazing pigs for full success require an abundance of leafy feed.

Utilization of Crops.

At times maize and millet grown for green feed are kept too late. Frequently, rather than take the risk of having them become woody or of having them cut down by frost, it is advisable to utilize them earlier and to employ the land thereby rendered vacant in growing one of the catch crops mentioned. As a rule, any portion of the maize or millet not required for green feed can be conserved as silage.

Lucerne and red clover also at times are allowed to become too woody at this season. Usually at this season the qualities vitally needed in crops are high digestibility, high mineral content, and high content of protein required for milk and flesh formation. In all these qualities there is a falling-off in green feed as it approaches maturity which is associated with woodiness.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Export of Fruit.

WHEN these notes appear the handling of the export fruit crop will have commenced in earnest, and a few reminders may perhaps not be out of place.

The benefits to be derived from making several select pickings have been mentioned in previous notes. It is advisable to obtain the advice of the local Orchard Instructor before commencing to pick a variety. It is a mistake to pick fruit too early before it is sufficiently mature. The first picking should be a light one, and only fruits of suitable maturity should be harvested. As the season for the respective varieties advances the problem becomes one of picking the fruit before it becomes over-mature, and growers and pickers should watch this carefully, particularly while waiting to secure increased colour on the fruit.

Bruising may be caused by careless emptying of picking-bags, by over-filling of orchard cases, by rough handling, by dirt and grit on the mechanical grader and in the packing bins, by too high a pack, &c. No effort should be spared to eliminate such causes of injury where they exist.

When lines of fruit of low colour or of fruit more than slightly russetted are being graded, a frequent examination of the fruit when it has reached the packing-bins is desirable By this means any tendency to fall below the standard in grading can be checked and corrected immediately.

There should be no need to emphasize the necessity for maintaining the standard grades set for fruit intended for export. A careful perusal of the grading standards set out in the export regulations is of value in avoiding misunderstandings and delays during the season.

The practice of " flag-wrapping " the fruit which is indulged in by some packers should be discontinued. It is not only slovenly, but to an extent defeats the main objects in wrapping the fruit. As the case is being packed the layers should be consolidated. The completed pack should be firm, and should have the requisite bulge. In completing the case the lidding should be done without bruising and the wire should be applied neatly and tightly. The stamping of the label should be done neatly and clearly, for too frequently the stamping is indistinct and in consequence fades altogether before the case arrives at its destination. To complete the good effect desired the particulars should be stamped parallel to or in alignment with other printed particulars upon the label.

It is advisable to use only new, bright, clean cases. Weathered and dirty cases should be discarded. A neat and tidy package creates the first favourable impression upon the buyer.

Local-market Fruit.

Too frequently with the exporter the local market is looked upon as a handy outlet for all his export rejects. In the rush usually associated with export the rejected fruit, including much of that which is immature, is hastily packed and forwarded to the local markets in the hope that it will bring a payable price. The fruit, besides being immature, often is packed poorly or indifferently in soiled, untidy-looking cases, and carelessly branded. It is because of this that disappointment with the poor prices realized for the fruit is often experienced.

This position may be met by permitting a larger proportion of the fruit carrying excess russet or too little colour for export to remain on the trees to tree-ripen. Such fruit is much more acceptable to the public. Varieties not intended for export should be allowed to reach a more forward stage of maturity before being harvested.

All diseased and useless fruit should be gathered and destroyed or deeply buried. Orchard hygiene is of great importance in lessening the carry-over of disease, and should not be overlooked in the general rush of work.

General.

In the orchard the general work now in the main consists of applying sprays to the later-maturing varieties, and these should be continued, especially upon susceptible varieties, for the control of leaf-roller caterpillar and black spot.

Tree-supports requiring adjustment should be attended to, and, where necessary, further support given to the limbs of the laden trees to obviate fractures and splitting at the crotch.

—*R. G. Hamilton, Orchard Instructor, Hamilton.*

Citrus Culture.

All citrus trees should benefit materially from the rains experienced during the month of January. An effort should be made to keep the surface well cultivated to prevent the excessive loss of moisture from the soil in the event of a dry spell being experienced. Wherever it is possible the mulching of the soil about the trees with dry litter not only assists in preventing the growth of weeds, but also affords protection against undue evaporation.

In harvesting the summer crop of lemons an endeavour should be made not to allow the fruit to become too large, but to pick it when it has reached from 2¼ in. to 2½ in. in size.

By the autumn the majority of the young growth will have hardened. In groves where it is still necessary to do a small amount of pinching and spacing of the shoots this should be done without further delay to give the new growth which develops as a result of this treatment every chance of becoming reasonably hard to be able to better withstand frosts that may come along later in the season. At the same time, as far as is practicable, old and worn-out portions of branches should be cut out.

The fertilizers applied at this period should not contain matter of a highly nitrogenous nature, but in the main should consist of phosphates and potash. A fertilizer, such as blood and bone, which becomes slowly available is preferable to sulphate of ammonia, as it does not force excessive wood-growth before the spring, and therefore can be used with safety.

Trees affected with red-scale should be sprayed while the scales are in the young unprotected or "crawler" stage with summer oil, 1 part oil by volume to from 33 to 40 parts water.

The moist weather being experienced is very conducive to the development of verrucosis, and a further spraying with Bordeaux mixture 3–4–50 should now be made; to this may be added nicotine sulphate 40 per cent. at a dilution of 1–800 if thrips are present. Unfruitful trees and trees of a poor type may be reworked by budding to a more suitable class of trees as soon as the necessary bud-wood can be obtained. All bud-wood should be obtained from shoots of selected trees which are of good habit and which produce the desired type of fruit.

Attention of growers is drawn to the provisions of the amended regutions relating to the sale, for consumption within the Dominion, of New-Zealand-grown fruit which have been recently gazetted and which contain grading standards for lemons.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Selecting Breeding Hens.

In view of the fact that the signs which go to indicate usefulness mostly disappear when the moulting process begins, and that just before that time certain signs, which indicate vigour, constitution, and production, manifest themselves in a marked way, no time should be lost now in selecting the breeding-hens for the coming season.

As the breeding-hen is the foundation of the poultry industry, and the poultry-keeper's future success depends very largely upon the class of bird he places in his breeding-pens, this work of selection is perhaps one of the most important and interesting jobs of the year. The art of breeding is the ability to select birds which, when mated, will produce offspring nearest to the standard or model aimed at. The successful breeder who year after year maintains, and even improves, the high quality of his stock knows what he is aiming at, as he has a definite model or standard to guide him, and has an affection for his birds, together with a great faith in the breed in which he is specializing. He is a real enthusiast and spends considerable time studying the various points of the individual birds, and finally he has that gift of weighing up at a glance the characteristics of a bird. Further, the successful selector and breeder of utility stock is not set back by a few disappointments. No doubt the art of selection is easier for some than for others, but when we think that the many breeds of poultry have been evolved from the jungle fowl it indicates that the art of selection can be cultivated. The three main points to keep in view when selecting utility breeding birds are—(1) purity of blood; (2) vigour and constitution; and (3) capacity to produce and reproduce.

Whatever breed the poultry-keeper takes up he should study the recognized standard for that particular breed, so that he becomes able to make the best possible selection of the birds at his command. For instance, to the uninterested person all Leghorns appear alike, but the more a person studies his breed, and the more natural aptitude he possesses, the more difference he will see in each individual.

A study of the standard is necessary in order to give a model to select by, for unless one has a definite model or object to aim at when selecting breeding-hens much permanent improvement can hardly be expected. Leghorn-breeders would do well to take as a model, when selecting breeders at this time of the year, bird No. 1, "a good breeding specimen," as shown on page 50 of this Department's Bulletin No. 66, "Utility-poultry Keeping."

Purity of blood is mentioned first, as experience has shown that mongrel birds are not profitable in comparison with a good strain of purebred utility birds.

As type and carriage are the chief characteristics of a purebred bird, these matters should receive consideration when selecting. Unfortunately, some utility-poultry keepers underestimate, or fail to appreciate, the value of these important items, with the result that one often sees many different types in a flock of the same breed and strain. The best breeders are known by the evenness of type in the birds they raise.

Though the object should be to breed birds as near to the standard as possible, it is well for the beginner to bear in mind that the finer arts of breeding cannot be mastered in a season or two. It is a good policy to start with a few birds of good type, and once that good type becomes well set in the flock the minor, or fancy points, can be given more consideration.

Vigour and Constitution.

Too much importance cannot be attached to constitution when it comes to selecting breeding stock, for the poultry-keeper who fails to realize the paramount importance of this characteristic, and endeavours to develop others, failing to watch closely vigour and constitution, sooner or later has to pay, perhaps heavily, for his neglect.

Naturally a good utility breeding-hen should be a good layer, but if hens that have laid well during the year show signs at the present time which indicate a lack of vigour or constitution, such as crooked breast-bones, weak flabby combs, or the laying of poor-shelled eggs, it is a mistake to use them for breeding-purposes. As mentioned in previous notes, the late moulters are usually amongst the strongest and best birds, and physical activity is perhaps the chief evidence of vigour and constitution, so poultry-keepers should look for the birds that are quick in movement, constantly on the hunt for food, and last to go to roost. If these birds are handled at night their crops are found to be large and full and their legs, which should be carried well apart, rather warm to the touch.

Slow-moving or sluggish birds are not, as a rule, very robust, and seldom possess that constitution necessary to lay eggs containing the fertility and vitality necessary to produce the best offspring. No doubt vigour and vitality may be improved by good management, but constitution can be depended upon only when it is inherited and bred into birds for generations. Years of experience have shown that when crooked breast-bones, weak flabby combs, or poor-shelled and small eggs start to show up in greater numbers it should be taken as a warning that the vigour and constitution of the flock are going back, and that more care is necessary in the selection of the breeding-stock, with perhaps the necessity of some fresh blood.

Capacity to Produce and Reproduce.

The only infallible way to ascertain the number and class of eggs each hen lays is by the use of the trap-nest, or single pen, and it is only by breeding from a bird and testing its offspring that one can ascertain the true value of a bird as a breeder. However desirable this practice may be, no

doubt owing to the want of suitable facilities and the cost of carrying out the work, very few utility-poultry keepers in this country adopt this system for selecting their breeding hens.

The usual practice is to select in the autumn, just before the majority of the birds start to moult. The most likely breeding specimens will be the late moulters, with heads fairly fine, showing strength and character, not coarse but rather wide at the top, and of fair length ; comb of medium size and thickness, but not coarse or flabby ; wattles of medium size, fine in texture, and carried close together ; feathering hard, tight, and dense, and often of a worn thread-bare appearance, while many good Leghorns will have a more-or-less straw-like tinge in the feathers at this time of the year. Body will show length, depth, and width, with a good crop-capacity and depth of abdomen. The back will be rather flat with good width, carried well back to the tail. The texture of the abdomen should be fine, silky, and flexible to the touch (a most important point). Legs will be carried well back and wide apart. With regard to size, this is a point which should be carefully watched, for as a general rule the tendency for the average size of flock of birds, especially if bred for great egg-production, is to get smaller. In fact, the better layers the birds are the more danger of deterioration, thus the more care necessary when selecting. Good eighteen-months-old breeding Leghorn hens should weigh from 4 lb. to 4¾ lb., and two-and-a-half year-olds from 4½ lb. to 5½ lb. each.

Some poultry-keepers are inclined to go for quantity at the expense of quality, which is a great mistake. If 40 per cent. of breeders can be selected from a flock of eighteen-months-old birds it is doing very well.

Where trap-nests or single pens are not used it is advisable after the breeding-hens have been selected to examine them carefully and select a few of the very best specimens for mating with the best male in order to breed cockerels for the following season's use. If this is done one is sure that the stud cockerels are from the best birds, and the quality of the flock is more likely to be kept at a high standard. It is the desire of the Department to assist poultry-keepers in keeping up the quality of their stock, and if those requiring advice on the selection of their breeding birds make application to the Department it will endeavour to make arrangements for an officer to visit their farms.

C. J. C. Cussen, Chief Poultry Instructor, Wellington.

THE APIARY.

Final Extracting.

WHERE extracting has been delayed for any reason it is advisable to use great caution in removing the honey. The combs should be removed as expeditiously as possible, and care should be exercised not to incite the bees to rob by keeping the hives open longer than it is necessary to remove the surplus. A hasty examination of the brood-chamber should be made in case it is found that the bees have not filled the combs in the lower story with honey. If empty or partly filled combs are found it is highly important that they be replaced with good combs of honey from the super. On no account should one attempt to extract any honey from the brood-chamber. Do not leave combs lying about or expose vessels that have contained honey. Unless caution is exercised in regard to these details, when the final extracting is being done the beekeeper is more than likely to cause the bees to start robbing in a wholesale manner.

Preparation for Winter.

The time is at hand when it is of paramount importance that proper preparation be made for winter. If the colonies are to winter in good order, so as to escape the abnormal winter losses which sometimes occur, then it

behoves the beekeeper to attend to the leading factors that produce successful wintering. The attendant evils of neglect are starvation, spring dwindling, and poor colonies, these latter being of little account when the next season's crop arrives.

There are many matters that call for attention in preparing the colonies for winter, and among the most important which make for success are a strong cluster of bees, a good queen, plenty of good stores, and protection. It is safe to say that too little attention is paid to wintering the colonies with strong clusters of young bees. Having secured a crop of honey, and noting that the colonies are strong in bees, the beekeeper is satisfied to trust to chance. At the close of the season the colonies are likely to contain a large force of bees, but the majority, having helped to gather the season's crop, are old, and in consequence cannot be taken into account in wintering the colony. As a result, unless large numbers of young bees are being raised to take the place of the old bees, the colonies will dwindle seriously in the spring or become a total loss in the winter. Every effort must be made to keep up breeding well into the winter, and it is often advantageous to stimulate the colonies by autumn feeding.

Next in importance to having a strong cluster of young bees is the necessity for the colony to be headed by a good queen Too little attention is paid to superseding failing queens. A queen that has laid vigorously during the honey season is likely to become worn out and her powers of reproduction diminished. In all cases these queens should be replaced and a vigorous young mother supplied. It often happens that the bees recognize a failing queen, and set to work to supersede her, but this work should be anticipated by the beekeeper. Other things being equal, stocks headed by a vigorous mother are likely to keep up late breeding, with a result that the colonies come out in the spring with a prolific queen, and the loss attendant upon queenless hives is greatly diminished.

If the beekeeper studies his interests and the welfare of his bees he takes care that every colony goes into winter quarters with plenty of good stores. This is a most important factor in successful wintering, and upon it depends largely the staving-off of starvation which faces the bees during the months which follow. The colonies that are supplied with honey winter safely and build up early in the spring and are ready to take advantage of the nectar from the early-flowering plants Beginners often ask how much honey should be left for the bees to winter on. The amount necessary must to some extent depend upon locality, and care must be exercised, more particularly in the South, to provide sufficient so that winter feeding may not have to be resorted to. In the North winter feeding may be successfully carried out, as there is not the same risk in breaking up the clusters as there is in the extreme South. In no case should a colony be left with less than 30 lb. of sealed honey, and it is wise to increase this amount to 40 lb. Abundance of stores is essential if winter losses are to be eliminated altogether.

Another important factor in the safe wintering of bees is that of protection. This may be provided for bees by housing them in a good watertight hive and protecting them by good shelter hedges or fences. Great annual winter losses occur in this country through lack of attention to hives, more particularly to the roofs. Leaky roofs should not be tolerated under any circumstances. When the roofs leak the mats and hives become damp, and the consequent drain on the stores is largely in order to keep up the heat of the cluster for safe wintering. Where the bees are kept dry the amount of food consumed to keep up the heat of the cluster is small compared with the stores eaten by the bees where proper protection has not been afforded by the beekeeper. New Zealand in general being a wind-swept country, it behoves the beekeeper to see that the bees are located in a sheltered position. Cool winds militate against brood-rearing, while they also prevent the bees from taking a cleansing flight during the spring months.

Care of Comb-honey.

There are factors in the proper treatment and care of comb-honey which the producer is apt to overlook when putting his honey on the market. Usually the practice followed is to despatch the crop to market, where it is sold, to be afterwards graded and cleaned by buyers who are alive to the demands of the local market. These buyers obtain a better price by grading and cleaning the comb-honey, whereas the producer can, by employing proper methods, demand an increased price. Comb-honey should be fully capped before removal from the hive, and it should not be left until its white appearance is destroyed by travel-stain, this being caused by the constant traffic in the hive. When the sections are removed they should be stored in a warm, dry room, as low temperatures hasten granulation, and granulated comb-honey is not likely to meet with ready sale. Moreover, comb-honey stored in a cold damp place is apt to "weep" (or absorb moisture from the atmosphere), forming beads on the surface of the comb, and in the course of time becomes sour, thus destroying its marketable value. As opportunity allows the sections should be cleaned of all propolis and stain, and this is best done by scraping the sections with a knife, and the operation finally completed by sandpaper. Care must be exercised not to damage the cappings of the comb and thus destroy its attractiveness.

Before forwarding the honey to market it should be carefully graded, and finally packed in cartons for the market. By the use of cartons the sections are secured from dust and insects and present an attractive appearance when offered for sale, besides being far less liable to breakage. In order to ensure safe transit excellent shipping-cases, which can be purchased from the hive-dealers, should be used. These cases are fitted with corrugated-paper cushions, which materially reduce the breakage from rough handling. A feature of these section crates is a sliding-cover which enables the honey to be readily examined. The crates are appreciated by the retailers, and at the same time help to increase the average price to the producer.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetables.

THE full enjoyment and economical use of many vegetables depend not only on a wise selection of varieties and careful culture ; sound consideration must be given to harvesting and storage if there is to be no loss in quantity and quality and the stocks are to be available over a maximum period. Under most conditions here such crops as celery, parsnips, salsify, artichokes, autumn-sown carrots, and beet may be left in the ground during winter, with quite satisfactory results, and lifted in dry weather as required until about the month of August, when growth is about to recommence. They must then be lifted and stored where the conditions are cold, well ventilated, and not too dry. Main-crop carrots maturing about the month of April split if left in the ground and become coarse and fibrous, as do main-crop beet maturing at that time. These should be lifted in fine weather as soon as they mature and given the storage conditions before mentioned.

A lean-to shed with a southerly aspect is often a suitable place, especially when shaded by plantation trees and having ample means for ventilation in the higher part of the roof. Such a place is also suitable for potatoes stored in bins, sacks, or boxes, if it is clean, well drained, and dark, but not so dry as to cause the tubers to shrink. Considerable losses from decay occur if the stocks are contaminated by the presence of decayed tubers or waste carried over from a previous season in the store or its vicinity. This can readily be avoided by the methodical disposal of decayed waste

at all times and a thorough annual clean-up of the store, which may very well include a careful spraying of the interior with a reliable fungicide. Losses from decay may also occur through infection caused by decayed tubers overlooked when bagging up in the field ; or a good crop, to all appearances sound, may be placed in the store and in a month may be in a useless condition due to the attack of the potato-moth. This attack, which is most likely to occur in warm, dry localities and seasons, may be avoided by picking up and bagging the tubers the same day as they are dug and placing them in a clean store. In this way the night-flying, egg-laying moth is unable to deposit on the tubers those eggs which later hatch out into caterpillar larvæ which tunnel the flesh and make tubers an early prey to organisms of decay. Doubtful stocks should be picked over after a month or two in storage, and if the infection is fairly extensive they should be used up as soon as possible. Large quantities stacked in a compact manner heat and sprout, especially in warm districts and in a store where attention to ventilation is neglected. In such localities they may be stored satisfactorily in slatted bins to a depth not exceeding 3 ft. or 4 ft., but in colder districts 6 ft. may be a maximum depth, as long as good ventilation is provided, except when there is danger of injury through frost. Where stocks are large and storage accommodation limited, a quantity for late use may be satisfactorily held in a pit or clamp outside if the tubers are quite sound. For this purpose a well-drained, cool position should be chosen and the pit made not more than 5 ft. or 6 ft. wide and the tubers piled as high as possible. To prevent heating the pit should not be completely sealed for the first few weeks ; during that period the soil casing over the straw or fern covering should only be carried up to within a foot of the ridge. If these conditions are observed and the potato crop is carefully dug in fine weather as soon as ripe, and allowed to harden off for a few hours before gathering, it will be used to best advantage.

The onion crop requires somewhat similar storage conditions, the chief difference being a drier atmosphere. The bulbs should be lifted as soon as ripe (this is of especial importance in districts inclined to be humid and warm), placed in windrows consisting of five or six rows of bulbs, until the tops wither completely. If wet weather is experienced the windrows are turned over by the use of a wooden rake. When thoroughly dry the bulbs are trimmed with shears and bagged or placed in slatted crates and stacked in an open shed for a few weeks to cure thoroughly before storage or shipping. When cured the bulbs are cleaned by taking away the dry outer scales, bulbs which have thick necks or which are damaged are removed, and the remainder are graded to size. They will then store satisfactorily if placed in a comparatively dry atmosphere that is cool, with an even temperature and given thorough ventilation at all times except in wet or humid weather. If in slatted boxes they are stacked, like fruit, with 1 in. space between tiers and rows to permit of circulation of the air; or they may be spread 6 in. or 8 in deep on slatted shelves; or small quantities may be "strung" and hung in a dry airy place in the old-fashioned manner. This latter method is particularly suitable for shallots held over for planting another season. All bulbs of this class deteriorate very quickly in a close atmosphere.

Vegetable marrows are best used in a green state when of a suitable size, but pumpkins, and what are known in America as winter-squash—such as the Hubbard varieties—should not be harvested until thoroughly ripe, but before they have been frosted. They are cut with a portion of the stem attached and left in the field to mature before carting. They must be handled and carted with care, as it is easy to injure them seriously at this stage. When they are stored in a warm, dry, airy place for a few weeks their shells harden and they then can stand somewhat lower temperatures and rougher handling if that is necessary.

In the warmer districts, especially where there is also a heavy annual rainfall, the ordinary late potato crop is rather difficult, but the sweet

potato, or kumara, generally grows well. For this and other reasons it is increasing in popularity in such areas. While the crop is best left growing as late as possible, it must be lifted before there is any frost or the tubers immediately under the crown are liable to injury. If frost kills the vines the kumaras should be dug immediately, as decay sets in on the dead vines and may pass down to the tubers. Digging must be done with the greatest care, as the slightest damage at this stage prevents the tubers keeping and storage losses are due chiefly to faulty handling before curing. Curing, which occupies about a week, is usually done by gathering the tubers into heaps and covering them with sacks every night, to dry them thoroughly before storage in a warm, dry chamber that can be ventilated in warm weather. Small quantities may be kept successfully by storing in sand so long as it is perfectly dry.

In the southern States of America where sweet potatoes are grown on a commercial scale the tubers are stored in crates, stacked to allow ample ventilation and to enable the air to circulate through them, in chambers that are heated to a temperature of about 80° F. for the first fortnight or so of the storage-period. When the roots are well dried off the temperature is allowed to drop to 55° and is held there for the rest of the storage period, giving ventilation freely when the weather permits. In this way, together with fresh crops such as celery, savoys, cauliflower, leeks, &c., also dry beans, pickles, and chutneys, the garden makes valuable contributions to the larder during the winter as well as the summer months.

To provide young spring onions at that season, when salads are so much in demand, a sowing should be made during the month of March—towards the end in the warmer districts. For this purpose the Rocca or Tripoli types are most suitable owing to their mild flavour and tender flesh. In warm districts with a considerable annual rainfall the sowing should be extended to also provide young plants for setting out in early spring that ripen their bulbs about the month of January, which is more satisfactory under such conditions than sowing the main crops in early spring as is done in the dry districts. The land selected for the seed-bed should be well drained and thoroughly cleaned of weeds by shallow cultivation for some time before sowing.

Where the tomato crop is of considerable importance it sometimes is advisable to select the seed under local conditions, so that while the fruit is of a type suited to one's requirements the plants are thoroughly acclimatized. Time and careful consideration should be given to the selection of plants from which seed is to be taken ; they should be free from serious disease, of good constitution, and carrying crops that are as satisfactory as possible in regard to quantity and quality. Fruit that is likely to be coarse or small should be removed from the bunches and the remainder allowed to ripen naturally on the plants, which should be flagged to enable them to be readily recognized. When the tomatoes are ripe they should be cut open and the pulp dropped into a little water. The water containing this pulp should be placed in a warm place and as soon as it commences to ferment it should be poured into a gravy-strainer and washed well under a tap of running water until clean seed only remains. The clean seed should be placed in a position where it dries quickly and well stirred frequently to prevent seeds sticking together. If the seed is stored in tins, or other airtight containers, it is as well to redry it after a short period to make sure of its condition. It should then remain in good condition for five years at least. When conditions are favourable for a good seed-harvest a generous supply should be taken to provide against contingencies. Another method of saving tomato-seed is to scoop the seeds from the fruit and let it drop on to sand that is quite dry and has been passed through a fine sieve ; the mixture should be well rubbed through the hands for some time and then spread to dry. When it is dry it should be rubbed again and sieved to remove the sand.

The Homestead Garden.

Land that has been cultivated to a fine tilth and cleaned by occasional hoeing to destroy seedling weeds, with a view to sowing it down in lawn, should now have the surface grades carefully adjusted and the ground consolidated by rolling when the soil is in a dry state. A moderate dressing of chemical fertilizers raked in, before broadcasting the grass-seed during calm weather, is generally advisable. The most suitable fertilizers for the purpose depend on local conditions, but in the fertile alluvial loam where the Green-keeping Research Committee at Palmerston North is carrying out its experiments a mixture composed of equal quantities of sulphate of ammonia and superphosphate at a rate of 1 oz. to the square yard has given excellent results, and may be taken as a basis for modification, as may be necessary, under other conditions. Under the above-mentioned conditions, which are frequently rather dry during the summer, a seed-mixture composed of two parts Chewings fescue (*Festuca duriuscula* var. Chewings) and one part of brown-top (*Agrostis tenuis*) at the rate of 1 oz. of the mixture to the square yard has given very satisfactory results. Under less fertile conditions the quantity might well be increased, and where there is a marked difference in soil and climate it would often be best to sow a mixture supplied by a local reliable seedsman. It is generally satisfactory after sowing the seed evenly to merely rake it in carefully.

Established lawns may now be given any extra attention that is necessary, such as returfing worn places, loosening up hard places with a fork, thoroughly raking the whole area and applying a light dressing of chemical fertilizer or a light top-dressing of a mixture composed of fine soil and manures. Where the lawns have been in constant use for games this attention is urgently needed and should be commenced as soon as the playing-season is finished, so that the most may be made of the interval between seasons which is generally all too short for this purpose.

A sharp look-out should be kept for insect pests. This is the season when damage may be done to lawns by the common earth-worm when numerous, or the subterranean caterpillar (*Porina*), or grassgrub (*Odontria zealandica*). Damage is best avoided by giving the matter prompt attention so soon as the attack is perceived.

—*W. C. Hyde, Horticulturist, Wellington*

REVIEW.

Profitable Poultry Keeping, by M. W. STEWART. 198 pp. Whitcombe and Tombs, Ltd.

THIS book, by an author well known to many poultry-keepers, is designed primarily to assist farmers to explore the possibilities of poultry-keeping as a side-line, and it is fitted to be of considerable service in doing this The advice it contains is given in simple, direct language, and the policy it enunciates is in general accord with that which has been advanced by the Department of Agriculture for many years. The book is obviously based on practical experience. It gives strict attention to the economic side of poultry-keeping as a business, and should prove decidedly useful on farms on which the farmer or members of his family desire to undertake utility-poultry keeping as a side-line The book rightly stresses that poultry-keeping as a side-line, to be successful, must be well done. To some extent the scope of the book is indicated by the titles to the sections. These include: Choice of stock, housing of poultry, breeding, hatching, chick rearing, growing stock, table poultry production, poultry feeding, culling, anatomy of a layer, poultry hygiene, notes on common ailments and diseases. The book contains a considerable number of well reproduced illustrations which usefully supplement the written matter.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

TRANSPLANTING ORANGE-TREE.

P. D. L. H., Gisborne :—

Please inform me the correct time and method of transplanting an orange-tree The tree in question is about 8 ft. high, and the trunk is about 12 in. in circumference at ground-level, and is at present bearing nearly two dozen oranges.

The Horticulture Division :—

A suitable time to remove the orange-tree would be towards the end of September, before new growth commences, performing the operation when the land is sufficiently dry and the weather dull without wind. Remove the fruit as soon as possible, and prepare the tree by cutting out dead wood and conflicting branches and by thinning other branches where they are at all congested. Then cut a trench round the tree, 2 ft to 3 ft from the base, going down until most of the horizontal roots are severed, and then working under the tree to sever the perpendicular roots. When all is clear allow the tree to lean to one side and fill in a little soil; then pull it over in the opposite direction and fill in a similar amount. By repeating this operation the tree roots are brought to the surface and the tree may be rolled on to a sledge for conveyance to its new site. A hole of ample dimensions for replanting should be dug before the tree is moved, and a supply of wet sacks should be available for covering the roots during removal to prevent them drying out Some good soil for filling in round the tree when replanting would be beneficial, and care should be taken to see that the tree does not suffer from want of water during the summer.

FREE-MARTINS.

J. B. V., Te Mata :—

Are there any free-martins in twin lambs? Please give reasons whether twin lambs of different sex will reproduce or not.

The Live-stock Division :—

There are no free-martins amongst twin lambs, or, if such occur, they have never been recorded. The free-martin in cattle is a term applied to an animal born twin to a bull calf having the external marks of a female but failing to develop the pelvic female generative organs which are necessary to reproduction. Such neuter cattle are often raised under the impression that they are heifers, and it is found at a later date that female characteristics are wanting. The cause of the condition traces back to early fœtal life. When a cow bears twins, separate fœtal membranes are usually formed with each twin. In the uterus the membranes come to lie in direct contact with each other and sometimes fuse together, thus forming a connection in the circulatory or blood systems of the two fœtuses. When this fusion takes place between fœtuses of opposite sexes, the testicular secretion from the male fœtus finds its way into the blood system of the female, inhibiting the development of the female genital organs and rendering the animal permanently sterile. The female lamb of a male and female twin will in sheep always be found to be a true female with definite female organs and capable of reproducing. Probably this is because the two ovaries in ewes tend to produce ova at the same time, and the ova when fertilized grow in different horns. Double ovulation or fission of one ova more frequently occurs in cattle.

Sir W. D. Hunt has been reappointed the representative of stock and station agents on the New Zealand Meat-producers Board.

WEATHER RECORDS: JANUARY, 1936.

Dominion Meteorological Office.

NOTES FOR JANUARY.

IN the North Island January was a very wet month. Most places in the Auckland and Hawke's Bay Provinces, indeed, had two to three times the average rainfall. In consequence, there has been unusual growth of grass, pastures are very green, and feed abundant. Stock generally are in very good condition and the milk-yield is high. The weather was, however, too wet for satisfactory haymaking, and much cut hay was lost. The pasture-growth is too abundant also for lambs to fatten very well. Fruit crops, especially stone fruit and tomatoes, suffered considerably from the excessive moisture.

In the South Island conditions were very different, rainfall being much below normal in most districts. On the other hand, there was very little westerly wind, and consequently an absence of dry and sunny weather Feed generally is plentiful, though in some parts fresh green pasture is lacking. Again, though stock are mostly in good condition, lambs are not fattening as well as usual. Wheat crops promise to be heavy.

In the country as a whole the season is a backward one, fruit and crops maturing as much as three weeks later than usual.

Rainfall —The great excess of rainfall in the North Island has already been mentioned. In the South Island there was an average deficit of about 50 per cent. In Nelson and Marlborough the falls approached the average, and Oamaru and Invercargill also had good rains. North Canterbury and the west coast had a particularly dry month.

Temperatures —Though the departures were nowhere very large, temperatures were generally above normal, especially in the interior and on the west coast.

Sunshine.—Sunshine was considerably above normal in the interior of the South Island at Lake Tekapo and Alexandra, and on the west coast at New Plymouth and Hokitika, but in most other places was below it. Hawke's Bay and Canterbury had unusually low values

Pressure and Storm Systems.—For the first five days of the month an anti-cyclone covered New Zealand, and the weather was fine. Between the 6th and the 8th, though pressure remained high to the east, a series of shallow depressions moved on to the Dominion North-easterly gales and heavy rain occurred in the North, North Auckland experiencing some flooding. Good rains were recorded over most of the North Island, but in the South they were lighter.

Between the 11th and the 17th a somewhat similar series of depressions made their appearance. General rains were again recorded. A north-easterly gale was experienced in the Auckland Province on the night of the 14th to 15th, and floods occurred in North Auckland and the Bay of Plenty. On the 17th there were northerly or north-westerly gales at many places.

The third series of depressions, which were again only shallow, arrived on the 22nd to 23rd. Once more there was flooding in North Auckland, though elsewhere the rain was generally light. Finally, on the 29th to 30th, northerly gales occurred about and south of Cook Strait in connection with a westerly disturbance, though there was little rain. Thunderstorms were fairly frequent during the month.

RAINFALLS FOR JANUARY, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	12·08	14	2·59	3·94
Russell	24·01	10	8·00	3·25
Whangarei	9·45	13	2·42	3·93
Auckland	6·89	15	1·78	2·97
Hamilton	..	..	..	3·57
Rotorua	10·82	16	3·83	4·18
Kawhia	5·61	8	1·27	3·55
New Plymouth	8·44	9	2·42	4·18
Riversdale, Inglewood	12·36	13	4·01	7·51
Whangamomona	7·95	9	2·01	5·58
Hawera	3·57	10	1·13	3·51
Tairua	6·78	12	1·33	3·66
Tauranga	4·38	18	2·00	4·03
Maraehako Station, Opotiki	10·50	16	3·30	3·59
Gisborne	4·36	13	1·93	2·72
Taupo	8·07	18	2·00	3·37
Napier	5·13	10	2·10	2·50
Hastings	4·70	14	2·05	1·93
Whakarara Station	7·52	15	1·60	..
Taihape	4·65	10	2·57	3·16
Masterton	..	..	..	2·56
Patea	3·83	11	1·22	3·59
Wanganui	3·70	6	1·71	2·83
Foxton	3·73	8	1·18	2·14
Wellington	3·34	8	1·16	2·89
South Island.				
Westport	2·97	10	1·33	8·30
Greymouth	5·61	16	1·70	9·17
Hokitika	3·79	13	1·68	10·10
Ross	3·64	7	1·97	12·40
Arthur's Pass	3·11	4	2·30	14·12
Okuru, South Westland	7·52	6	3·20	12·59
Collingwood	10·77	9	6·22	6·71
Nelson	3·08	10	1·24	2·90
Spring Creek, Blenheim	1·92	8	0·64	2·22
Seddon	2·61	8	0·71	1·84
Hanmer Springs	1·51	11	0·58	3·95
Highfield, Waiau	0·84	10	0·21	2·98
Gore Bay	1·03	13	0·22	2·46
Christchurch	1·25	10	0·73	2·33
Timaru	1·55	11	0·38	2·39
Lambrook Station, Fairlie	1·17	6	0·33	2·43
Benmore Station, Clearburn	1·36	10	0·50	2·77
Oamaru	2·56	12	0·70	2·04
Queenstown	2·60	7	0·88	2·87
Clyde	0·88	6	0·29	1·85
Dunedin	1·56	12	0·58	3·41
Wendon	1·63	11	0·35	3·20
Balclutha	0·62	5	0·35	2·31
Invercargill	4·11	21	0·60	4·00
Puysegur Point	7·85	21	1·90	7·62
Half-moon Bay	3·16	14	0·61	4·83

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THE FOOT-ROT DISEASE OF WHEAT.

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FOOT-ROT of wheat is a condition associated with the presence of one or more pathogenic fungi on the underground parts of the plant. In recent years a good deal of attention has been paid to the disease in other wheatgrowing countries, and the following is an account of an investigation of the disease as it occurs in Canterbury.

SYMPTOMS.

The disease may be observed throughout the growing period of the crop, and the symptoms at the different stages are described below.

Seedling Blight.—Wheat-fields examined six to seven weeks after sowing are found to contain certain dead seedlings or seedlings showing discoloration and wilting. Such seedlings do not occur in patches but are distributed evenly along the rows, among apparently healthy plants. They can be pulled up easily, when it is noticed that the underground portion of the stem has rotted through above the grain (see Fig. 1). In 1934 the degree of seedling blight in crops examined was as high as 22 per cent.; in 1935 two fields were examined in which there was over 40-per-cent. loss of the seedlings.

Spring-yellow.—In early spring, backward, yellowish, tip-withered plants may be observed. These may be scattered, or the whole crop may be affected. They possess a poorly developed root system, characterized by the absence of fibrous roots. It appears that the seedlings are attacked as in the case of seedling blight, and the underground stem rots through, but, in the condition known as spring-yellows, adventitious roots develop above the "foot-rotted" area and enable the plant to survive. According to growth conditions these seedlings apparently recover from the attack to some extent and produce small ears. Spring-yellow seedlings are also shown in Fig. 1 along with typical examples of seedling blight.

Whiteheads.—The presence of "whiteheads" soon after flowering, when the crop is still green, has often interested the farmer. "Whiteheads" is usually a secondary condition resulting from the fracture of tillers at the ground-level. Laboratory examination of pieces of such fractured tillers has shown that in some cases pathogenic foot-rotting fungi were responsible. In other cases, however, the fracture has been shown to be due to weevil attack(1).

Wheat-scab.—At harvest-time there may be found among normal ears a number of small ears covered with pinkish-brown lesions. Sometimes the florets are sterile and contain a mass of pink fungoid growth. Any grain formed is usually shrunken and bleached. This condition has been proved to be caused by the same organism responsible for the other conditions described. Bennett(2) found that the fungi do not cause scab by growing up the stem from the soil or infected seed, but that fungus-spores from infected soil are blown on to the flowering ear, where they germinate and produce a fungus growth, causing the diseased-ear condition.

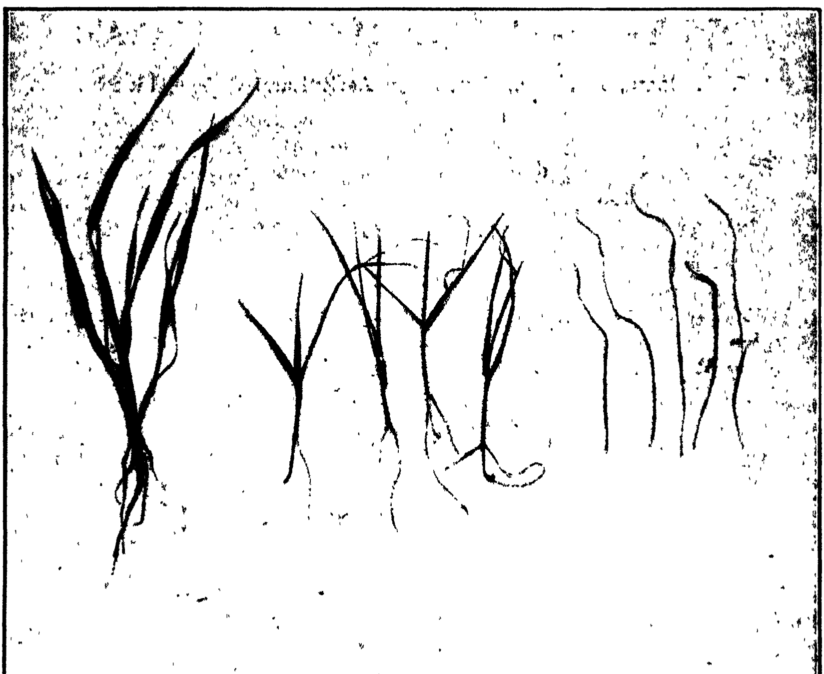

FIG. 1.

Left: Normal healthy seedlings.

Centre: Spring-yellow seedlings. Note development of adventitious roots above the point where underground stem has rotted through.

Right: Typical examples of seedling blight; all specimens gathered from one field of Tuscan wheat about six weeks after sowing. [*Photo by J. W. Calder.*

Economic Importance.

Foot-rot is responsible for considerable plant mortality and loss in yield. In 1926–27 yield losses of 50 per cent. to 70 per cent. were recorded in England(3). Weniger(4) estimated that the disease caused a loss of 6,000,000 bushels of wheat in North Dakota in 1919. The disease is considered the most economically important in Australia as far as wheat is concerned. Geach(5) reports plant losses of 20 per cent. to 30 per cent. in New South Wales, and Geach estimated the average annual yield-reduction at the very conservative figure of 2½ per cent.

No previous work has been conducted on the disease under New Zealand conditions, but it has been known to be present for a number of years. Reports indicate that the conditions described above are becoming more prevalent, and it would appear that in the past the condition has been confused with take-all (*Ophiobolus graminis*), or with grub, or with weevil attack.

During the course of a two years' investigation throughout the Canterbury wheatgrowing area, a mortality of 10 per cent. at the seedling stage was quite common, and in some fields was as high as 46 per cent.

Causes of the Disease.

Simmonds(6), in Canada, found that certain species of fungi occurring free living in the soil and in diseased grain were responsible for the disease. The chief of these fungi proved to be species of *Helminthosporia, Alternaria*, and *Fusaria*. During the past two years laboratory isolations from dead and diseased wheat plants and grain revealed the presence of a pathogenic form of *Fusarium*. This has been identified as *Fusarium culmorum* and appears to be widespread as the principal cause of the disease. *Helminthosporium* was very rarely found, but *Alternaria* were the most commonly occurring fungi on grain, although they were rarely isolated from foot-rotted seedlings.

Nature of the Disease.

The pathogenic organism causing foot-rot appears to be a weak parasite, and the incidence of the disease depends upon a balance between host plant and parasite. If the soil and cultural conditions are such as to promote a vigorous development of wheat-plants, the crop apparently grows away from the disease. On the other hand, when conditions are against normal healthy development of the crop, the condition of balance swings in favour of the fungus and the disease appears to be more or less severe according to the vigour of the crop. There are certain predisposing factors associated with the appearance of the disease, and for the purpose of studying these a survey was made of wheat crops at various stages of development. The question of varietal susceptibility was considered. Tuscan, Hunters, Cross 7, Jumbuck, Marquis, Hollow-strawed Tuscan, Velvet, and Garnet all revealed some degree of seedling blight, and all these varieties appear to be equally susceptible to attack. This general susceptibility of varieties was the first evidence of the presence of a number of predisposing factors which are considered below.

Conditions associated with the Disease.

The following is a summary of the results of the field survey of over 100 wheat crops in various districts throughout the Canterbury wheat-growing area.

The Effect of Cropping Rotations.—Of the crops examined, only thirteen showed no sign whatever of seedling blight. Of these thirteen crops, some had been sown after wheat, grass, mangels, rape, red clover, and peas in the rotation. On the other hand, many instances were found

where infected crops followed each of these in the rotation. As a result of the field survey, the conclusions drawn with regard to the effect of rotations were—

(i) Foot-rot is likely to occur after any crop:
(ii) The most severely infected fields were all sown after summer fallow for twitch:
(iii) Growing wheat for two to three years on one area does not appear to result in increased infection.

Other Host Crops.—Varying degrees of infection of the same variety sown after the same kind of crop led to an examination of the possibility of other hosts acting as sources of infection. In all fields where there happened to be a heavy infestation with *Agropyron repens* or old-man twitch the percentage of seedling blight was always high. Pieces of the rhizomes of twitch from affected fields were examined in the laboratory, and pathogenic *Fusarium* cultures were obtained. Old stubble of previous wheat crops was also shown to be a carrier of *Fusarium* fungi. On one farm perennial rye-grass had been sown down in a field which, during the previous year, had been badly affected with seedling blight of wheat. Eight months after sowing the rye-grass, patches of stunted plants stood out distinctly. The underground portions of such plants were found to be carriers of *Fusarium* fungi.

The appearance, therefore, of badly diseased crops of wheat in fields infested with twitch, or sometimes after grass or a diseased crop, may be explained by the fact that the organism is able to persist in a field by these means. In Canada(7) brome-grasses and barley-grass have also been shown to be carriers of foot-rot fungi.

Influence of Soil Fertility.—The disease appeared to be more severe on heavy wheat land than on lighter land. This is in keeping with the belief of Bennett(2) that the presence of much organic matter in the soil enables the organism to live saprophytically for long periods. Concerning soil fertility as influenced by the use of artificial fertilizers, all crops examined were manured with superphosphate or with proprietary mixtures. There was no connection between the kind of manure or the quantity applied and the incidence of the disease, which varied from 0 per cent. to 46 per cent. of seedling-blight infection.

It is interesting to note that one farmer drilled several alternate strips in a 30 acre field of autumn-sown Tuscan without any super. At the seedling stage these unmanured strips stood out distinctly as being more infected with seedling blight and spring-yellows than the manured strips.

This is further evidence in favour of the hypothesis that factors promoting vigorous growth of the plant tend to decrease its susceptibility to attack. In connection with soil fertility, acidity-measurements were made of the soil of several wheatfields affected with the disease, and the results showed that where the soil acidity was high the percentage of seedling blight was also high.

THE CONTROL OF THE DISEASE.

The conclusion regarding this aspect of the problem is that there is no specific means of control which will give immediate results. It has been indicated that there are several factors which predispose the plant to attack by foot-rotting fungi. If conditions favour the pathogenic organism occurring naturally in the soil on organic matter or on other

host plants and seed, a severe attack of the young seedlings will take place. Control methods, then, must aim at building up the resistance of the plant by cultural methods to ensure normal healthy plant-development or by treatment of the growing crop. As the disease is to some extent seed-borne, seed-treatment as a means of control must also be considered.

CULTURAL CONTROL.

Crop Rotations.—It has been found that during 1934 and 1935 in Canterbury the disease occurred after all the commonly grown crops, and was not likely to be any more severe after wheat than after peas, for example. This suggests that ordinary cropping rotations in the Canterbury wheatgrowing area cannot be altered to any extent to bring about a reduction in the incidence of foot-rot.

Where a field is badly diseased one year the farmer will certainly not be advised to sow wheat again on the same area for some years, as the soil is probably badly infected.

Cultivation.—Schmidt and Feistritzer(8) concluded that " Foot-rot of wheat was reduced by directly turning under the stubble to a depth of 34 cm. (13½ in.). The practice of skim-ploughing the stubble perpetuated the disease. Deep ploughing therefore seems desirable." Land should be made as clean as possible by the removal of carriers of the disease—viz., *Agropyron repens* and other hosts. It was noticed that heavy infection occurred on loosely consolidated fields, probably due to deep sowing, while on an infected field in which wheat plots were sown by hand, and which was consolidated by tramping, no disease appeared in the wheat plots following the diseased field crop. A well cultivated and consolidated seed-bed favours vigorous growth, and this is associated with low infection.

Effects of Time of Sowing.—In a time-of-sowing trial duplicate plots were sown at fortnightly intervals in soil artificially inoculated with cultures of a pathogenic *Fusarium* isolated from typical diseased plants. The results are shown in the following table:—

Table 1.—Showing Germination Percentage in Fusarium-inoculated Rows of Wheat sown at Fortnightly Intervals.

Time of Sowing	Average Germination.	
	Control.	Inoculated.
1935.		
April 16	100	82·5
April 30	100	82·5
May 14	99	79·0
May 28	99	75·0
June 11	98	60·5
June 28	98	71·0
July 9	98	79·5
July 23	99	86·0
August 7	98	86·5
August 14	97	88·0

From this table it is seen that the winter-sown crops are more severely attacked by foot-rotting fungi than spring- or autumn-sown crops. From the end of May until the end of June the most severe mortality occurred. This corresponds with that period when growth and germination are very slow. Later on, as in August, the development of young plants appears to be sufficiently vigorous to be able to withstand the fungus attack to a greater extent.

The Effect of Depth of Sowing.—In a similar manner triplicate plots were sown at different depths in inoculated soil. The results are summarized in Table 2.

Table 2.—Germination Percentage of Fusarium-inoculated and Non-inoculated Plots sown at Different Depths on 20th June, 1935.

Depth of Sowing.	Control.	Inoculated.
4 in.	75·0	57·0
3 in.	81·0	65·0
2 in.	82·5	75·5

The results suggest that the deeper the seed is sown the more predisposed it is to attack by foot-rotting fungi.

CROP-TREATMENT CONTROL.

By crop treatment is meant the use of artificial fertilizers to stimulate plant-growth. It has been seen that manurial treatment does not prevent the disease. On the other hand, it may be a means of control by stimulating diseased plants to healthy development.

With this in view, a top-dressing trial was conducted in the spring of 1934 on an area of a wheatfield badly infected with seedling blight and spring-yellows. A mixture of superphosphate and sulphate of ammonia was applied at the rate of 2 cwt. per acre. Observations were made on the reaction of marked plants in the diseased area. The spring-yellow plants were found to have responded remarkably to the stimulus of manurial top-dressing, whereas the untreated plants succumbed later in the season or developed into very poor and stunted plants, which did not come into ear.

From these observations it will appear that plants checked (not those killed by seedling blight) in the seedling stage recover to a considerable degree if the plants are stimulated by fertilizers. By encouraging the early development of the susceptible or slightly affected plants, they "outgrow" the effect of the disease organism. Figs 2 and 3 show the effect of top-dressing at two stages in a crop-development.

SEED-TREATMENT CONTROL.

A review of work on this aspect shows that although seed-treatment methods have been tried extensively, they have been attended with little success. Greaney(9) inoculated soil with *Fusarium* and found that pickled seed was not significantly better than untreated. On the other hand, Christensen and Stakman(10) found that barley-seed treated with Ceresan resulted in significantly better stands and more vigorous growth of seedlings in soil inoculated with *Fusarium.*

A seed-treatment trial was conducted during 1935. Five replicates of pickled and unpickled seed were sown in *Fusarium*-inoculated and non-inoculated soil. The results, expressed as percentages of germination, are shown in the following table :—

Table 3.—Effect of Seed-pickling in Plots inoculated with Fusarium.

Seed unpickled, Soil non-inoculated.	Seed unpickled, Soil inoculated.	Copper carbonate, Soil inoculated.	Ceresan, Soil inoculated.	Agrosan, Soil inoculated.
85	77·8	83·8	81·8	80·6

FIG. 2. EFFECT OF TOP-DRESSING : SIX WEEKS AFTER TREATMENT.

Left : Typical *Fusarium* spring-yellow seedlings which had not been top-dressed.

Centre : As above, but which had been top-dressed with superphosphate and sulphate of ammonia.

Right : Typical healthy plant, which had received no treatment

[*Photo by I. D Blair.*

In this trial seed pickled with Ceresan, Agrosan, and copper carbonate and sown in *Fusarium*-inoculated soil all gave significantly better germinations than unpickled seed. However, infection was not very severe, and, in spite of the seed treatment, the mortality was higher in the inoculated plots compared with the non-inoculated, indicating that seed treatment cannot be relied on as a control measure.

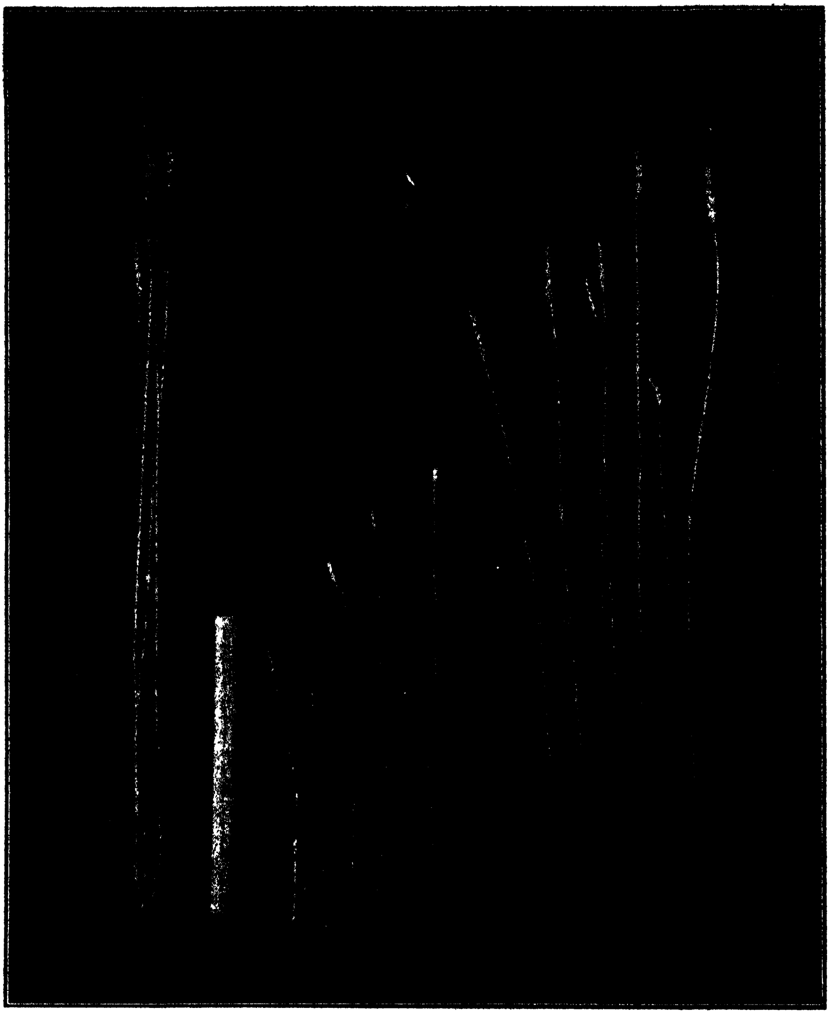

FIG. 3. EFFECT OF TOP-DRESSING: HARVEST STAGE.

Left: Typical healthy plant, without top-dressing.

Centre: Plants which developed from *Fusarium* spring-yellow seedlings, and which had not been top-dressed.

Right: As above, but which had been top-dressed with superphosphate and sulphate of ammonia. [*Photo by J. W. Calder.*]

SUMMARY.

Foot-rot of wheat is a symptom of a disease caused mainly by *Fusarium* fungi which attack the roots and underground parts of the plant. As a result of attack during the growing-season, different conditions described as seedling blight, spring-yellows, whiteheads, and scab are all associated with the disease. The organism occurs also on *Agropyron repens*, rye-grass, and certain weed-grasses, and can persist

in a soil on an aftermath of diseased crops. It is also seed-borne. It has the character of a weak parasite, which becomes serious in its effect when the plant is weakened by such adverse growing-seasons as cold, deep-sowing, poor tilth, &c. Control must be directed towards the preparation of a weed-free firm seed-bed and avoiding sowing too late in the season—*i.e.*, very cold soils. Top-dressing diseased crops in spring alleviates the severity of the disease. Seed-pickling as a means of controlling foot-rot does not seem to offer much promise.

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CHEMISTRY OF WEED-KILLERS.

(Continued.)

VI. THE BISULPHITE GROUP.

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EXPERIMENTS in which ammonium thiocyanate (sulphocyanate) was used as an agent for killing ragwort (*Senecio jacobaea*) were described in the March, 1935, issue of this *Journal*, and in continuation of the series of articles similar trials with another class of chemical—namely, bisulphites—are described herein.

As in the previous articles, the weed chosen for the experiments is that one at present giving the greatest anxiety to the cattle-farmers of this Dominion, the ragwort (*Senecio jacobaea*).

In these experiments three different bisulphite salts were used—sodium bisulphite ($NaHSO_3$), potassium bisulphite ($KHSO_3$), and sodium ammonium bisulphite ($NaNH_4(HSO_3)_2$). In addition, a locally obtained commercial bleaching-powder, consisting largely of sodium bisulphite, was tried.

PROPERTIES OF THE BISULPHITE COMPOUNDS.

The sodium and potassium salts are in the form of finely divided, non-combustible, and non-poisonous, white powders, while the sodium-ammonium bisulphite is of a brownish appearance and is more coarse-grained. The substances under discussion do not absorb moisture in the same way as do thiocyanates and those proprietary chlorate preparations which contain calcium chloride to reduce fire risks; their dry nature rendering them convenient for handling and mixing with other compounds. Bisulphites gradually liberate a little sulphur di-oxide gas under certain conditions, and may therefore lose some of their potency as weedicides if the materials are unduly exposed to air. They are manufactured principally for bleaching purposes, and are usually sold in a fairly refined state in air-tight, metallic drums of ½ cwt., 1 cwt., and 5 cwt. size.

The salts are readily soluble in water, with the exception of the sodium-ammonium bisulphite, which is rather slow in dissolving at a 15-per-cent. strength.

The bisulphites have the advantage compared with ammonium thiocyanate: that the utensils employed do not tend to rust and corrode.

SPRAYING TRIALS.

The Lower Hutt and Rotorua trials were conducted simultaneously and in the same localities as the previously described thiocyanate experiments.

Lower Hutt.—In the spraying experiments conducted in this district the plots were each 24 square yards in area, and the solutions were applied at the rate of 200 gallons per acre, as this was the minimum quantity which would give complete coverage with the small spraying-apparatus used. After treatment the plots were kept under frequent observation, and the percentage of kills recorded are based on the number of surviving plants when the latest counts were made some months afterwards.

The results of the various spraying experiments are summarized below:—

Treatment.	Sprayed.	Result.
Sodium bisulphite—		
5 per cent	2nd November, 1934 ..	Unsatisfactory.
10 per cent.	,, ..	,,
15 per cent.	,, ..	95-per-cent. kill.
Sodium ammonium bisulphite—		
5 per cent	,, ..	Unsatisfactory
10 per cent.	,, ..	,,
15 per cent.	,, ..	85-per-cent. kill.
Potassium bisulphite—		
5 per cent.	23rd November, 1934 ..	Unsatisfactory.
10 per cent. (cut) ..	,, ..	95-per-cent. kill.
10 per cent. (uncut)* ..	,, ..	90-per-cent. kill.
15 per cent.*	,, ..	90-per-cent. kill.
Sodium bisulphite—		
15 per cent.	7th December, 1934 ..	Unsatisfactory.

* The spray-pump was not working satisfactorily, and gave uneven coverage during the application of these two solutions. With normal working-conditions the results would probably be about 95-per-cent. kill, or even higher, with the stronger solution.

The ragwort on the plots sprayed with 15-per-cent sodium bisulphite on 7th December was at a more advanced stage of growth, and was just entering the flowering-stage. The ragwort on one of the plots treated with 10-per-cent. potassium bisulphite was cut a fortnight before the spraying, and in the interval the plants had regrown sufficient foliage to enable them to be covered with an effective quantity of spray. The results indicate that the cutting in this particular case made no appreciable difference, whereas experiments with other weed-killers—*e.g.*, chromates—have shown that spraying after cutting before there is any regrowth gives unsatisfactory results.

After treatment the pasture on the plots had a very bleached appearance, and although checked for several days it quickly recovered, and in most cases was back to normal again in less than a month.

Rotorua.—Mr. C. R. Taylor, a field officer of the Department at Rotorua, conducted a number of experiments with bisulphite compounds on ragwort-infested farms on pumice soils. The following is a summary of his report on treatments made early in November, 1934, when the weather conditions following the spraying were moderately moist :—

10-per-cent. solution sodium ammonium bisulphite: Very unsatisfactory.

10-per-cent and 20-per-cent. solutions sodium bisulphite: Severe on all vegetation, grass almost normal in three weeks, 100-per-cent kill of ragwort, thistle, plantain, catsear, daisy, hawkweed, &c. The weaker solution was less severe on the pasture.

10 per-cent. and 20-per-cent. solutions of potassium bisulphite and the bisulphite bleaching-powder obtained locally gave results similar to the sodium bisulphite. The potassium bisulphite was more severe than the sodium salt. Mr. Taylor considered that probably a 5-per-cent. or 7-per-cent. solution of the bisulphites would give the best all-round results.

Miramar.—During December, 1935, experiments were carried on with bisulphites in this locality, where the ragwort-infestation is greater than in the Lower Hutt experimental area, averaging about 55,000 plants per acre. The soil is an exceptionally heavy clay loam, and the weather at the time of spraying and for some weeks afterwards was fairly dry. The results of 12-per-cent. solutions of both sodium and potassium bisulphite at 200 gallons per acre were not satisfactory.

It is interesting to note that at Miramar the plants are much smaller and mature later than is customary for ragwort in the North Island. They appear to be hardier owing to their being exposed to the strong northerly and cold southerly winds which characterize the climate near Wellington's seaboard. The plants certainly appear more resistant to chemical sprays, and it is as yet difficult to say whether this is due to the soil condition, climate, type of plant, or a combination of these factors. Even treatments with sodium-chlorate solution under the conditions at Miramar are not always completely successful—for example, the kills being 75 per cent. to 80 per cent. and less with 3-per-cent. to 5-per-cent. solutions.

Dry Applications.

The method of applying the weed-killer dry, mixed with superphosphate, as previously described in the article on ammonium thiocyanate, was also tried with the locally-obtained bisulphite bleaching-powder. Five plots were treated with different quantities of the material, equivalent to amounts varying from ½ cwt. to 4 cwt. per acre, which were mixed with superphosphate applied at the rate of 4 cwt. per acre. Although the foliage on the plots had a bleached appearance for the first week, the treatments were entirely unsuccessful, and after a period of approximately a month the plots were practically normal in all respects. One plot which was treated with the bisulphite alone at the rate of 2 cwt. per acre showed a slight reduction in the number of ragwort plants. Since the ragwort plants on these plots were large and tall a considerable amount of the material was caught in the foliage, and in the absence of rain it remained there for some time before reaching the base of the stems and the roots. In the interval the bisulphite may have decreased gradually in potency. Treatment on smaller plants or under more moist conditions would possibly be more successful.

Dry applications of sodium bisulphite were made on young ragwort using one of the mechanical devices described in the previous article. The apparatus liberated a small quantity of material each time it was stamped on the crown of a ragwort plant. The operation was very effective, resulting in practically 100 per cent. of kills, but, of course, only individually treated plants were affected.

Discussion.

A comparison of the effects of the treatments in the various experimental areas shows that 10-per-cent. solutions of both sodium and potassium bisulphite gave 100 per cent. of kills at Rotorua, while at Lower Hutt they were both unsatisfactory. In the latter experiments the small plots were laid down on areas thickly infested with ragwort where the entire plot required spraying, and the solution was applied at the rate of 200 gallons per acre. At Rotorua Mr. C. R. Taylor applied the spray to each plant or clump of plants until well wetted all over with solution, and drops just began to fall from the foliage, care being taken not to spray the pasture any more than could be helped. The marked differences in the results may therefore be attributed to differences in the volumes of solutions used, but as it is possible that Mr. Taylor applied less solution than the 200 gallons per acre sprayed at Lower Hutt, another explanation may have to be sought. The failure of the treatments at Miramar also requires some explanation.

Crafts (" Effectiveness of Sodium Chlorate as a Herbicide," *Hilgardia*, Vol. 9, 1935, page 437), in a comprehensive series of experiments, showed that sodium chlorate is more effective when applied to the soil than when applied as a spray to the foliage of the various weeds. Further, the effectiveness of spraying the living foliage involves the complicating factors of rapid absorption by the foliage and subsequent root-killing by translocation of the toxic chemical within the plant. These two factors are in turn governed by the time of day the spray is applied, stage of growth, and amount of moisture in the soil. Pammel, in his exhaustive treatise on " Weeds of Farm and Garden " (1920), draws attention to the importance of atmospheric moisture, temperature, wind, and amount of dew at the time of spraying-operations.

According to Crafts, the effectiveness of applications of the chemical to the soil depends on the porosity of the soil, and proper vertical distribution of chlorate within the soil by sufficient leaching rains. He found that when advantage is taken of all factors influencing treatment through the plant and through the soil the effects are apparently additive and the best results are obtained.

In the light of Craft's work the loose, porous character of the Rotorua pumice soils may explain the success of weed-killing treatments in that locality, compared with the less satisfactory results on the less-porous, heavy clay soil of Miramar. The Lower Hutt soil may be regarded as intermediate in texture, being of an alluvial type.

The unsatisfactory results of the 15-per-cent. sodium bisulphite sprayed on flowering ragwort at the Hutt, compared with the 95-per-cent. kill obtained with similar treatment five weeks earlier, suggests that this class of chemical is unsuitable for treating mature ragwort.

Mr. Taylor had a similar unsuccessful experience at Rotorua on flowering ragwort in January, but the treatment was quite satisfactory on small plants still in the rosette stage. However, the good kills obtained from another treatment late in February, following some weeks of heavy rain, led him to believe that the variations in the results were due to differences in the weather conditions and not the stage of growth.

From our experience it would not be advisable to spray ragwort in flower, owing to the danger of the seed being previously set and remaining viable after the treatment. If the infested pasture were grazed as closely as possible before spraying, less protection would be afforded young ragwort plants by the grass and any damage to the pasture minimized.

CONSIDERATIONS REGARDING COSTS OF TREATMENTS.

It is very difficult to estimate the costs per acre using bisulphites as weed-killers because the quoted prices are for the ordinary technical products. For weed-killing purposes the chemicals need not be so refined, and the manufacturing processes could probably be simplified to procure a cruder grade of material at a lower price This applies particularly to potassium bisulphite, which, owing to the method of manufacture, is obtained in the pure crystalline form costing about £50 per ton c.i.f.e. New Zealand ports. However, the manufacturers mentioned that if it were successful for weed-killing purposes, "no doubt a satisfactory way of obtaining a commercial product might possibly be found." The quoted price of approximately £17 per ton for sodium bisulphite, also landed in New Zealand, is for the ordinary commercial product, but here again the manufacturers mentioned that a cruder grade could perhaps be made at a lower price. As already stated, the sodium ammonium salt was made only for the experimental purposes, and apparently is not sold commercially, although it should not cost a great deal more than the sodium bisulphite. It is not considered suitable, for so far it has not proved to be successful.

From the foregoing remarks it should be obvious that the cost of bisulphite treatment for ragwort cannot be ascertained till there is sufficient demand for the materials to enable the manufacturers to produce a suitable grade for weed-killing purposes at a lower price.

However, it should be stressed that the sodium bisulphite could be retailed at the principal ports at approximately 3d. a pound, while the prices of sodium chlorate and ammonium thiocyanate vary from round about 4½d. to 6d.,* and 6d. to 8d. per pound respectively, according to the quantities purchased. This means that 10-per-cent. and 15-per-cent. solutions of sodium bisulphite would be no more expensive than, say, 5-per-cent. to 7½-per-cent. solutions of the other two chemicals. If a 7½-per-cent. solution of sodium bisulphite were found to be effective, as has been suggested by the Rotorua experiments, the cost would probably be very close to the cheapest effective solutions of either sodium chlorate or ammonium thiocyanate. A reduction could be made in the cost of potassium bisulphite to allow for the fertilizing-value of the potash.

To sum up, the Lower Hutt experiments have shown that, quite apart from considerations of price and properties of materials, including fertilizing-values, solutions of 10-per-cent. ammonium thiocyanate, 5-per-cent. sodium chlorate, 15-per-cent. sodium bisulphite, and 10-per-cent. and 15-per-cent. potassium bisulphite are approximately equally efficient for ragwort killing. At Rotorua it was considered that 5-per-cent. sodium chlorate was slightly superior, 10-per-cent. sodium and potassium bisulphites occupied an intermediate position, while 5-per-cent. and 10-per-cent. ammonium thiocyanate take third place, the superiority of the chlorate over the other two classes of chemical being very small indeed.

The unsuccessful results of the Miramar experiments suggest that further trials and more definite information will be required before recommendations can be given for the practical application of bisulphites treatment for ragwort extermination.

* Sodium chlorate is landed in the stores of the main New Zealand ports for about 5d. per pound. There is a Government subsidy of 1d. per pound, and thus it is possible to sell large quantities of the material for 4½d. per pound. All the prices mentioned exclude freight within New Zealand, hence the cost in inland districts may be considerably greater.

PELARGONIUM - RUST.

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Pelargonium-rust (*Puccinia pelargonii-zonalis*) is restricted to the cultivated geranium (*Pelargonium zonale* l'Herit), on which it is common in New Zealand. The causative organism has been recorded from South Africa, France, and Australia, and was first recorded in New Zealand in 1923.*

Symptoms.

Infected plants are characterized by leaf spotting and premature leaf-fall (Fig. 3). The first symptom of the disease is the appearance of a pale yellow green spot about $\frac{1}{16}$ in. in diameter on the upper surface of the leaf. The spot increases in size, almost immediately becoming visible on the lower surface where the central area ruptures, revealing

* Cunningham, G. H. (1923): *Trans. N.Z. Institute*, Vol. 54, pp. 619–704. Cunningham, C. H. (1931.) The Rust Fungi of New Zealand, xx + 261 pp.

a powdery chocolate-brown tuft of spores surrounded by a light-coloured "halo" area. As the chlorotic area increases in size further pustules erupt near the periphery. These coalesce, forming a spore-bearing ring about the original pustule and separated from the healthy tissue by a narrow "halo." Following heavy infection, the leaf turns

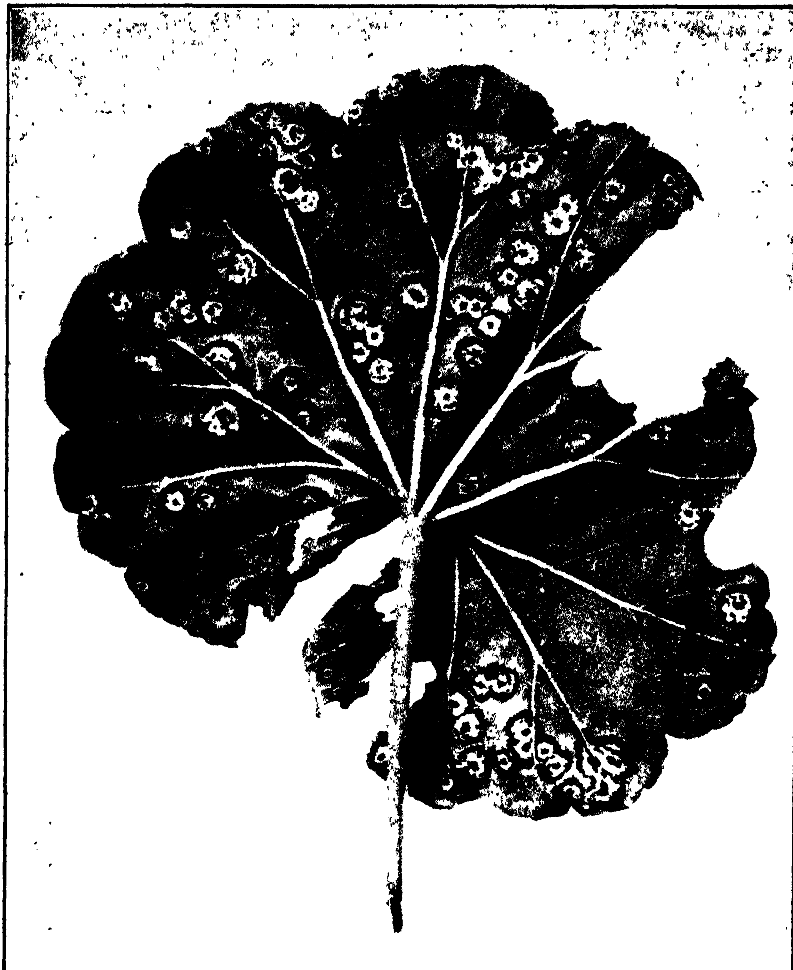

FIG. 1. TYPICAL RUST-INFECTION ON A PELARGONIUM LEAF (TELEUTOSORIAL STAGE). X 1. [Photo by E. B. Levy.

yellow and the infected portions appear as green spots. The spore-bearing areas eventually acquire a dark brown to black shiny surface.

Though unusual, a small tuft of spores occasionally develops on the upper surface of the leaf in the centre of an infection spot. The rust also produces spore-bearing rings on bracts, and attacks leaf-stalks and petioles, producing powdery longitudinal pustules half an inch or more in length.

Life-history and Morphology of the Fungus.

Pelargonium rust is caused by *Puccinia pelargonii-zonalis* Doidge,* a rust fungus having only uredospores and teleutospores in its life-cycle. At present the function of the teleutospores is not understood, and the organism appears to be perpetuated by air-borne uredospores, which are produced on infected plants throughout the year.

A spore may alight on a geranium leaf, and if conditions are suitable it germinates, producing from a germ-pore an infection hypha, which enters the leaf-tissues. Here the hypha branches, ramifying between the host-cells and ultimately producing a compact mass of mycelium beneath the lower epidermis. From this mycelium arises a columnar tissue of conidiophores, from the apices of which uredospores are formed. The pressure exerted by the developing uredospores ruptures the epidermis of the leaf and thus releases the spores. Uredospores are produced while the leaf remains green, but as it withers teleutospores are formed in their stead. These persist as a single layer over the spore-bearing surface after the leaf falls.

Experiments on Control.

Experiments to test the efficacy of sulphur sprays on the control of pelargonium-rust were carried out in two series (*a*) in the glass-house,† and (*b*) outdoors.

(*a*) In the former series‡ naturally infected potted plants were used. Each spray treatment was applied to two pots, and five pots remained unsprayed as checks. The unsprayed plants were so placed that spores liberated from them would fall on the sprayed plants. Sprays were applied at weekly intervals from 6th April until 25th May, 1932. The spray treatments and the effects on rust infection are recorded in Table 1.

Table 1.—Spraying Glasshouse Pelargoniums for Rust-control.

Treatment.	Total Number of Leaves.	Total Number of Sori.	Average Number of Sori per Leaf.
Precipitated sulphur 10 lb. per 100 gallons	24	104	4·3
Precipitated sulphur 20 lb. per 100 gallons	8	20	2·5
Colloidal sulphur 2 lb. per 100 gallons ..	15	55	3·6
Colloidal sulphur 4 lb. per 100 gallons ..	20	23	1·2
Lime-sulphur 0·083 per cent. polysulphides	42	36	0·9
Lime-sulphur 0·1 per cent. polysulphides	18	12	0·6
No spray (check)	53	2,582	48·7

In the glasshouse the best control was given by lime-sulphur sprays, particularly that containing 0·083-per-cent. polysulphides. (The 0·1-per-cent. polysulphide spray caused leaf scorch.) Both colloidal and precipitated sulphur sprays reduced infection considerably, but left prominent deposits on the leaves.

* Doidge, Ethel M. (1926): *Bothalia*, Vol. 2, p. 98.

† During these experiments it was noticed that plants raised in an isolated glasshouse from infected cuttings stripped of leaves and washed under a tap before planting did not become infected during the eighteen months they were under observation.

‡ Thanks are due to Mrs. C. E. Purton, of Palmerston North, who made available the plants and glasshouse used in this experiment.

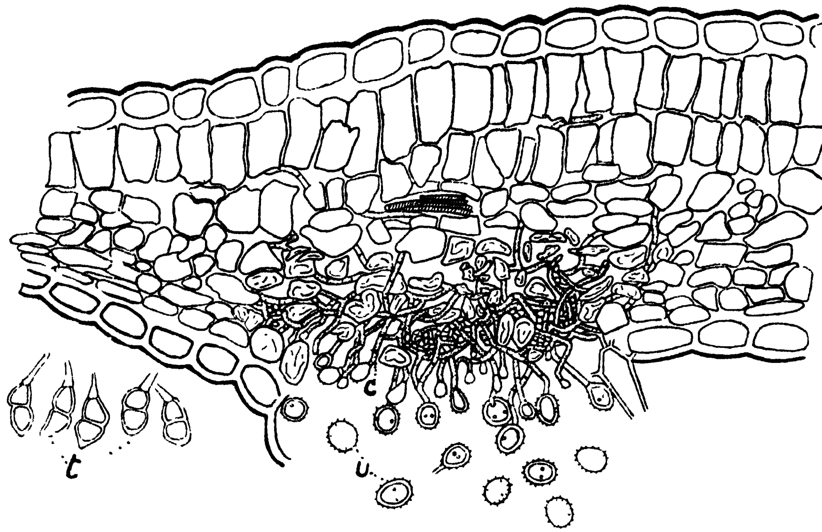

FIG. 2. LEAF SECTION SHOWING RUST PUSTULE x 150.
u = uredospores; *t* = teleutospores; *c* = conidiophores

Original.

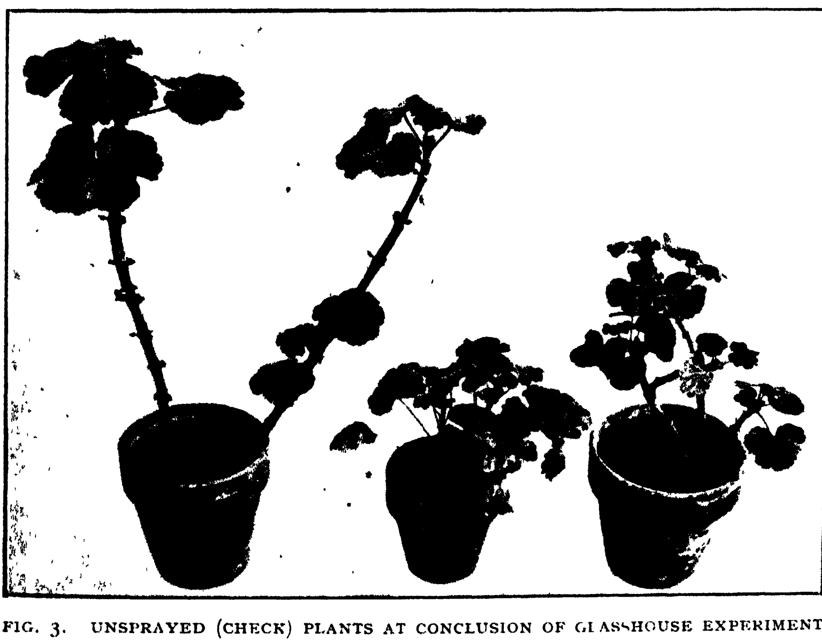

FIG. 3. UNSPRAYED (CHECK) PLANTS AT CONCLUSION OF GLASSHOUSE EXPERIMENT.

[*Photo by H. Drake*

(*b*) In the outdoor experiments lime-sulphur and colloidal sulphur were applied at weekly intervals from the 8th December, 1933, until the 13th April, 1934. Unsprayed plants were grown 4 ft. from the sprayed to serve as checks. Counts of infected leaves were made at the conclusion of the experiment and the results are tabulated in Table 2.

FIG. 4. PLANTS SPRAYED WITH LIME-SULPHUR AT CONCLUSION OF EXPERIMENT.
[*Photo by H. Drake.*

Table 2.—Spraying Outdoor Pelargoniums for Rust-control.

Treatment.	Number of Plants.	Leaves present.			Leaves infected.			Per Cent. of Leaves infected.	Number of Sori.
		Green.	Dead.	Total	Green.	Dead.	Total.		
Colloidal sulphur 2 lb per 100 gallons	4	526	..	526	..	..	..	..	..
Colloidal sulphur 4 lb. per 100 gallons	4	650	64	714	..	..	..	..	..
Lime-sulphur 0·083-per-cent. polysulphides	3	427	98	525	18	..	18	3·4	31
Lime-sulphur 0·1-per-cent. polysulphides	4	507	104	611	21	..	21	3·4	41
Check (unsprayed) ..	4	596	291	887	359	195	554	66·0	*
Check (unsprayed) ..	4	509	147	656	255	127	382	57·0	*

* In these cases sori were extremely numerous.

Outdoors complete control was secured with colloidal sulphur sprays at 2 lb. and 4 lb. per 100 gallons. A small amount of infection developed on the plants sprayed with lime-sulphur. As in the glass-house, 0·1-per-cent. polysulphides again caused leaf-scorch.

CONSIDERATIONS AFFECTING CONTROL AND CONTROL-MEASURES.

Pelargonium rust is initiated by wind-borne spores which, given favourable conditions, may cause infection of any geranium plant on which they alight. The disease overwinters on plants in sheltered positions about the garden and on cuttings in the glasshouse.

To prevent the disease:—

(1) Plants in sheltered positions should be pruned rigorously during the late autumn and the diseased material burned. They should be sprayed after pruning with 2 lb. colloidal sulphur per 100 gallons ($\frac{3}{4}$ oz. per $2\frac{1}{2}$ gallons).

(2) The leaves and bracts of cuttings should be removed and the stems washed thoroughly under a tap.

(3) When the disease appears in the glasshouse, plants should be sprayed at weekly intervals with lime-sulphur containing 0·083-per-cent. polysulphides, or, if outdoors, with 2 lb. of colloidal sulphur per 100 gallons.

TESTING OF PUREBRED DAIRY COWS.

REVIEW OF THE NEW ZEALAND CERTIFICATE-OF-RECORD SYSTEM IN 1935.

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A SURVEY of the result of certificate-of-record testing for the calendar year 1935 in comparison with 1934 indicates a marked falling-off in the number of certificates issued, while there were fewer outstanding individual performances. The reasons are not far to seek. Entries for the period under review were made in the late winter and early spring of 1934 when the dairying outlook was by no means promising, and breeders of pedigree dairy cattle no doubt felt disinclined to commit themselves to the comparatively high cost involved in certificate-of-record testing. The long dry summer and autumn of 1934-35 prevented many cows from attaining the yield of which they would have been capable under more normal climatic conditions. First-class certificates-of-record were issued to 554 cows in 1935, as compared with 637 cows in 1934, 450 cows being in the yearly-test division and the remaining 104 in the 305-day division, the comparative figures for 1934 being 534 and 103 respectively.

(1) C.O.R. YEARLY TEST DIVISION.

The 450 certificates issued during the year represented an average production of 516·3 lb. butterfat, a decrease of 11·15 lb. over the 1934 average of 527·45 lb. fat for 536 certificates. (In 1934 two cows each received two certificates, which accounts for the difference of two between the number of cows and number of certificates for that year.)

FIRST-CLASS CERTIFICATES ISSUED.

The total number of cows which have been granted first-class certificates since the inception of the certificate-of-record system in 1912 has now reached 9,428. Subdivided into breeds this total represents 6,914 Jerseys, 1,764 Friesians, 453 Milking Shorthorns, 219 Ayrshires, 68 Red Polls, 2 Guernseys, and 8 Shorthorns. Table 1 provides a numerical summary of yearly certificates of the first class issued during the past two years :—

Table 1.

Breed.	1935. Ordinary.	1935. Repeat.	1935. Total.	1934. Ordinary.	1934. Repeat.	1934. Total.
Jersey	352	28	381	415	41	456
Friesian	44	12	56	41	18	59
Milking Shorthorn..	10	..	10	9	3	12
Ayrshire	1	..	1	2	..	2
Shorthorn ..	1	..	1	..	..	..
Red Poll	..	1	1	6	1	7
Totals ..	409	41	450	473	63	536

SECOND-CLASS CERTIFICATES ISSUED.

Twenty-four second-class certificates were issued during the year, 18 being gained by Jerseys, 5 by Friesians, and 1 by a Milking Shorthorn. The previous year's total was 35. In the past year the average production of the 18 Jerseys was 555·27 lb. fat, the 5 Friesians averaged 515·28 lb., while the 1 Milking Shorthorn was credited with 566·28 lb. fat.

THIRD-CLASS CERTIFICATES.

Third-class certificates issued during the year numbered 140, comprising 74 Jerseys, 64 Friesians, and 2 Milking Shorthorns. The average of the Jerseys was 495·09 lb. fat from 8,866·8 lb. milk in 355 days, for the Friesians 583·13 lb. fat from 16,763·9 lb. milk in 353 days, while the 2 Milking Shorthorns averaged 347·42 lb. fat from 8,185·8 lb. milk in 365 days. With regard to third-class certificates it should be explained that this classification is of recent origin, having been in existence for only three years. Breeders have been given an opportunity to obtain certificates on records made in past years and for cows hitherto regarded as unqualified. Of the 64 Friesian certificates granted last year, 41 related to performances made in earlier years. Any cow which qualifies for first- or second-class certificate in all respects save subsequent calving is entitled to receive a third-class C.O.R.

PERIOD BETWEEN CALVING.

The average period between calving for commencement of test and calving subsequent to test for the 450 cows granted first-class certificates in 1935 was 404 days, as compared with 403 days for the preceding

year. The corresponding period for the second-class cows was 463 days, which is the same as for 1934. The rules governing the testing provide for a maximum period between calvings of 455 days for first-class certificate and 485 days for second-class C.O.R. It is therefore interesting to note that last year the average cow qualifying for first-class certificate calved fifty-one days within the period allowed, while the second-class cows failed for their first-class certificates by eight days.

JERSEYS.

Class Leaders.

No changes took place in the Jersey class leaders during the year. The highest Jersey for 1935 was Coniston Goldie, owned by Mr. R. Waterhouse, of Takanini. Commencing test at the age of 5 years 330 days, Coniston Goldie gained a certificate for 13,579·3 lb. milk containing 918·96 lb. fat in 365 days. This is certainly an outstanding cow, and on her performance as a junior two-year-old was at one time leader of that class on a record of 742·71 lb. fat. The present Jersey class leaders are as follows :—

Table 2.

Name of Cow and Class.	Tested by	Age at Start of Test	Fat required for Certificate.	Yield for Season. Days.	Milk.	Butter-fat.
		Yrs dys.	lb.		lb.	lb.
Junior Two-year-old. Beechlands Summer Lass	A. Moreland and Sons, Te Rapa	1 343	275·5	365	15,467·2	899·25
Senior Two-year-old. Ivondale Golden Rainbow	P. J. Petersen, Waitara	2 311	271·6	365	12,962·2	768·46
Three-year-old. Ivondale Silver Rainbow	P. J. Petersen, Waitara	3 327	309·7	365	15,073·4	950·63
Four-year-old. Woodlands Felicie	P. J. Petersen, Waitara	4 364	384·9	365	17,332·6	1,220·89
Mature. Holly Oak's Annie..	W. T. Williams, Pukehou	5 9	350·0	365	18,522·7	1,056·49

Jersey Class Averages.

The number of certificates issued to Jerseys in the yearly division declined from 456 in 1934 to 381 in 1935. The average production represented by those 381 certificates was 511·73 lb. butterfat, being some 6·29 lb. less than the previous year's average of 518·02. A study of the results according to age class indicates that the falling-off occurred

FIG. 1. CONISTON GOLDIE (R. WATERHOUSE, TAKANINI).

Highest C.O R. Jersey, 1935; age, 5 years 330 days: 13,579·3 lb. milk, 918·96 lb. butterfat.

FIG. 2. HUA BROOK PERFECT LADY (H. SALWAY, BELL BLOCK).

New class leader in mature class, 305-day test division: 12,837·1 lb. milk, 676·13 lb. butterfat.

"N.Z. Dairy Exporter" photo.

principally in the junior two-year-olds, all other classes except the four-year-old showing an increase. The averages class by class for 1935 and 1934 are given in Table 3 :—

Table 3.

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
	1935.		lb.	lb.
Junior two-year-old	160	360	7,990·5	455·34
Senior two-year-old	40	357	8,988·7	499·60
Three-year-old	60	361	9,994·1	560·23
Four-year-old	42	356	9,900·5	564·92
Mature	73	358	10,435·2	576·13
	1934.			
Junior two-year-old	188	360	8,246·7	473·65
Senior two-year-old	46	356	8,442·2	492·32
Three-year-old	60	359	9,439·1	540·59
Four-year-old	47	355	9,868·9	566·31
Mature	115	355	10,239·6	569·31

The averages, class by class, of all certificates issued to Jersey cows since the commencement of the C.O.R. system in 1912 are given in Table 4 :—

Table 4.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Junior two-year-old	3,113	349	7,234·6	407·17
Senior two-year-old	826	346	7,929·1	447·92
Three-year-old	1,153	346	8,672·6	485·28
Four-year-old	799	348	9,231·6	515·96
Mature	1,883	347	9,564·6	526·45
All .. .. Average test, 5·58 per cent.	7,774	347	8,291·3	463·16

Jersey C.O.R. Bulls.

Our list of Jersey bulls which have sired C.O.R. cows now includes 2,522 names, and of these 510 have qualified for the C.O.R. bull class. A bull is classed as a C.O.R. bull when he has four or more daughters with first-class certificates, each daughter being from a different dam. Thirty-three bulls have now qualified for the Jersey Cattle Breeders' Association's champion butterfat bull class, the qualifications for this class being as follows : Each bull must have five or more daughters which under first-class C.O.R. conditions have produced 520 lb. butterfat when starting test up to three years of age, 580 lb. when starting between three and four years of age, 640 lb. when starting between four and five years of age, or 700 lb. when five years old or over. It is not necessary for each daughter to be from a different dam. (The corresponding standards for cows in the 305-day test are 460 lb., 510 lb., 560 lb., and 620 lb. butterfat respectively.)

Friesians.

Class Leaders.

None of the Friesian performances of the past year seriously challenged the class leaderships. Credit for the highest Friesian record for 1935 goes to Paepaetahi Michaelmas Rosebud, a six-year-old cow owned by Mr. A. F. Perkins, of Taradale, Hawke's Bay, and which gained a certificate for 900·43 lb. fat from 22,815·9 lb. milk in 365 days. It is also desired to place on record the gaining of another certificate by Totara C.R. Buttercup, bred and tested by the Piri Land Co., Auckland.

FIG. 3. PAEPAETAHI MICHAELMAS ROSEBUD (A. F. PERKINS, TARADALE).
Highest C.O.R. Friesian, 1935 · 22,815·9 lb. milk, 900·43 lb butterfat.

Unfortunately this was a third-class C.O.R., the cow's production being 879·06 lb. fat making an average of 957·60 lb. fat for five successive lactations. Her individual records to the end of 1935 are as follows :—

Totara C.R. Buttercup.

Age.		Days.	Milk.	Fat.
Yrs.	dys.		lb.	lb.
2	205	365	21,208·6	790·66
3	247	365	25,885·3	989·10
4	267	365	27,108·1	1,079·14
5	308	365	28,073·0	1,050·07
7	9	365	23,622 6	879·06*
Average	..	365	25,179·5	957·60

* Third-class C.O.R.

Totara C.R. Buttercup is now on test for her sixth successive lactation, and her yield to date indicates that she will eclipse her last year's performance, which was made under the severe handicap of a most unfavourable season climatically.

The Friesian class leaders are as follows :—

Table 5.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Monavale Queen Bess	T. H. Richards, Cardiff	2 16	242·1	365	20,501·1	740·50
Senior Two-year-old.						
Pareora Echo Blossom	T. Sheriff, Clandeboye	2 223	262·8	365	22,671·9	819·81
Junior Three-year-old.						
Monavale Queen Bess	T. H. Richards, Cardiff	3 56	282·6	365	21,609·3	800·18
Senior Three-year-old.						
Totara C.R. Buttercup	Piri Land Co., Auckland	3 247	336·7	365	25,885·3	989·10
Junior Four-year-old.						
Totara Veeman Lulu	Piri Land Co., Auckland	4 12	349·7	365	22,364·2	946·78
Senior Four-year-old.						
Totara C.R. Buttercup	Piri Land Co., Auckland	4 267	375·2	365	27,108·1	1,079·14
Mature.						
Alcartra Clothilde Pietje	Vernon Marx, Mangatoki	7 355	350·0	365	31,312·5	1,145·24

Friesian Class Averages.

The number of cows of this breed which received certificates in the yearly division in 1935 was 56, compared with 59 for the preceding twelve months. In keeping with the general position, average production declined, being 622·87 for 1934 and 563·95 for the period under review. The Friesian class averages for 1935 and 1934 are as follows :—

Table 6.

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
	1935.		lb.	lb.
Junior two-tear-old ..	18	365	13,446·5	479·04
Senior two-year-old ..	5	365	13,927·4	516·54
Junior three-year-old ..	2	365	16,880·7	691·17
Senior three-year-old ..	7	321	15,773·9	550·08
Junior four-year-old ..	3	336	17,719·2	583·43
Senior four-year-old ..	5	334	16,429·7	587·15
Mature	16	350	17,281·1	653·57
	1934.			
Junior two-year-old ..	14	363	13,867·5	493·01
Senior two-year-old ..	9	365	15,257·4	563·57
Junior three-year-old ..	7	365	17,577·3	632·50
Senior three-year-old ..	5	358	17,851·5	685·89
Junior four-year-old ..	4	330	15,868·0	561·55
Senior four-year-old ..	3	356	18,965·2	674·62
Mature	17	352	20,212·7	744·10

The averages, class by class, of all certificates issued to Friesian cows since the commencement of the C.O.R. system in 1912 are given in the following table :—

Table 7.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Junior two-year-old ..	656	347	11,941·6	424·46
Senior two-year-old ..	271	348	12,822·9	457·08
Junior three-year-old ..	193	343	13,584·9	479·46
Senior three-year-old ..	198	337	14,167·7	508·53
Junior four-year-old ..	137	345	15,333·5	542·63
Senior four-year-old ..	136	347	16,215·2	568·68
Mature	598	343	16,177·5	570·71
All	2,189	344	14,031·9	497·26
Average test, 3·54 per cent				

Friesian C.O.R. Bulls.

Three new names were added to the Friesian C.O.R. bull list during the year, the total now being 120. Some 632 sires are represented in the 1,795 Friesian cows (including the 305-day division) certificated to the end of 1935.

Milking Shorthorns.

Class Leaders.

One change took place in the Milking Shorthorn class leaders during the year, this occurring in the senior two-year-olds, in which class Messrs. Ranstead Bros.' Matangi Quality 5th, with 542·66 lb. fat, gives place to Messrs. G. D. Hall and Son's Pinedale Beauty 4th, with 580·62 lb. fat. Credit for the highest performance of the year goes to Allandale Lady Clare, owned by Messrs. R. S. Allan and Son, Hatuma, her record being 17,147·1 lb. milk containing 705·93 lb. fat in 365 days on a test commenced at 3 years 337 days old. The Milking Shorthorn class leaders are now as follows :—

Table 8.

Name of Cow and Class.	Tested by	Age at Start of Test	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
Junior Two-year-old.		Yrs. dys.	lb.		lb.	lb.
Matangi Quality 4th..	Ranstead Bros., Matangi	2 109	251·4	365	14,572·8	591·89
Senior Two-year-old.						
Pinedale Beauty 4th	G. D. Hall and Son, Otorohanga	2 362	311·7	365	13,273·0	580·62
Junior Three-year-old.						
Matangi Quality 4th..	Ranstead Bros., Matangi	3 153	292·3	365	16,281·4	678·02
Senior Three-year-old.						
Matangi Ruth 2nd ..	Ranstead Bros., Matangi	3 304	307·4	365	14,032·7	747·86
Junior Four-year-old.						
Matangi Matilda 4th..	Hon. Mrs. E. J. Blyth, Kohimarama	4 0	313·5	358	14,640·2	630·38
Senior Four-year-old.						
Ashley Bank Winsome	Peach Bros., Sefton	4 298	378·3	365	17,687·7	730·93
Mature.						
Glenthorpe Lady ..	A. J. Melville, Buckland	Mature	350·0	365	20,136·2	856·85

Milking Shorthorn Class Averages.

Ten cows of this breed received certificates in 1935, being two less than in 1934. Their average production was 465·78 lb. fat from 10,863 lb. milk in an average milking-period of 353 days. Two of the cows were in the junior two-year-old class, three in the senior two-year-old, two in the junior three-year-old, and one each in the senior three-year-old, senior four-year-old, and mature class.

FIG. 4. ALLANDALE LADY CLARE (R. S. ALLAN AND SON, HATUMA).
Highest C.O.R. Milking Shorthorn, 1935 : 17,147·1 lb. milk, 705·93 lb. butterfat.

The averages, class by class, of all certificates issued to Milking Shorthorn cows since the commencement of C.O.R. testing for this breed in 1914 are given in the following table :—

Table 9.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Junior two-year-old ..	56	348	8,395·0	345·59
Senior two-year-old ..	43	350	9,042·0	376·90
Junior three-year-old ..	28	336	9,596·2	388·98
Senior three-year-old ..	32	344	10,999·8	457·26
Junior four-year-old ..	26	350	11,097·5	454·38
Senior four-year-old ..	34	343	11,623·3	462·59
Mature	280	341	11,807·0	473·01
All	499	343	10,960·5	443·02
Average test, 4·04 per cent.				

Milking Shorthorn C.O.R. Bulls.

One Milking Shorthorn bull qualified for the C.O.R. class during the year, the total now being fifteen. Some 148 sires are represented in the 453 cows of this breed certificated to the end of 1935.

Ayrshires.

Class Leaders.

Only one Ayrshire qualified for first-class C.O.R. in 1935, her performance making no change in the class-leadership list for the breed, which is as follows :—

Table 10.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Two-year-old.						
Fair Maid of Greenbank	W. Moore, Homebush	2 27	243·2	365	12,281·3	673·56
Three-year-old.						
Maesgwyn Victoria ..	C. Morgan Williams, Kaiapoi	3 250	302·0	365	16,507·7	646·98
Four-year-old.						
Ivanhoe Fancy ..	A. M. Weir, Menzies Ferry	4 308	344·3	365	14,207·7	713·93
Mature.						
Floss of Braeside ..	W. Moore, Homebush	7 287	350·0	365	20,305·5	832·72

Ayrshire Class Averages.

The averages, class by class, for all certificates issued to Ayrshire cows since the commencement of C.O.R. testing in 1912 are given in the following table :—

Table 11.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Two-year-old	70	346	8,997·0	373·33
Three-year-old	38*	347	10,043·0	414·16
Four-year-old	27*	346	11,378·0	459·52
Mature	110*	348	11,942·9	485·96
All .. .. Average test, 4·09 per cent.	245	347	10,744·3	439·73

* No additions during 1935.

Ayrshire C.O.R. Bulls.

No further Ayrshire Bulls qualified for the C.O.R. class during the year, the total remaining at 11, while 124 sires are represented in the 221 Ayrshire cows (including the 305-day division) certificated to the end of 1935.

Red Polls.

Class Leaders.

One Red Poll cow was certificated during the year, this being in the mature class. There was no change in the list of class leaders, which remains as follows :—

Table 12.

Name of Cow or Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season. Days.	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Two-year-old.						
Wayward 6th B No. 1	G. S. Young, West Plains	2 188	259·3	365	11,228·0	511·42
Three-year-old.						
Dominion Gold Top	Central Development Farm, Weraroa	3 302	307·2	365	9,491·25	459·46
Four-year-old.						
Wayward 6th B No. 1	G. S. Young, West Plains	4 297	343·2	365	13,290·0	580·05
Mature.						
Waihou Pip ..	W. Jackson, Waihou	7 25	385·0	365	12,681·8	537·90

Red Poll Class Averages.

The averages, class by class, for all certificates issued to Red Poll cows since the commencement of C.O.R. testing for this breed in 1918 are as follows :—

Table 13.

Class	Number of Certificates.	Average Yield for Season. Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Two-year-old . ..	42	345	7,500·6	336·21
Three-year-old	16	346	7,905·1	349·63
Four-year-old	8	349	9,806·8	430·72
Mature	26	341	10,501·0	443·67
All	92	344	8,646·8	377·13
Average test, 4·36 per cent.				

Red Poll C.O.R. Bulls

Twenty-seven different sires are represented in the sixty-nine cows of this breed (including one in the 305-day division) certificated to date. No new names were added to the Red Poll C.O.R. bull list during the year.

(2) C.O.R. 305-DAY TEST DIVISION.

First-class 305-day certificates issued during the year under review numbered 104, and of these 94 went to Jerseys, 8 to Friesians, and 2 to Ayrshires. In addition, 5 Jerseys were granted second-class certificates in the 305-day division.

Jerseys.

Class Leaders.

There was one change in the class leaders during the year. This occurred in the mature class, Mr. J. A. Mitchell's Perfection's Hopeful, with 664·51 lb. fat yielding place to Mr. H. Salway's Hua Brook Perfect Lady, which gained a certificate for 676·13 lb. fat. The class leaders are now as follows:—

Table 14.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Erinview Moss ..	J. Murray, Woodville	2 25	253·0	305	10,294·0	576·44
Senior Two-year-old.						
Erinview Joan ..	J. Murray, Woodville	2 330	284·4	305	10,130·1	607·08
Three-year-old.						
Glendale Silver ..	A. Montgomerie, Kawhata	3 319	318·9	305	11,352·7	631·42
Four-year-old.						
Hatcliffe Lady Gay ..	H. J. Kaye.. ..	4 60	329·5	305	10,619·9	664·49
Mature.						
Hua Brook Perfect Lady	H. Salway, Bell Block	6 5	360·0	305	12,837·1	676·13

Jersey Class Averages.

The production averages according to age class of the ninety-four first-class certificates issued to cows of the Jersey breed during the year under review are given in Table 15. The average for all the cows was 421·41 lb. fat, and the average test 5·46 per cent.

Table 15.

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
	1935.		lb.	lb.
Junior two-year-old ..	35	300	6,422·7	368·66
Senior two-year-old ..	15	300	7,759·9	410·71
Three-year-old	21	297	8,190·0	438·01
Four-year-old	6	293	8,794·1	478·44
Mature	17	300	9,323·1	498·83

Friesians.

Class Leaders.

No changes took place in the Friesian list of class leaders for the 305-day division, the position remaining as follows:—

Table 16.

Name of Cows and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season. Days.	Milk.	Butter-fat.
		Yrs. dys	lb.		lb.	lb.
Junior Two-year-old.						
Sealands Magpie Pietertje 2nd	H. G. A. Cameron, Weraroa	2 22	252·7	305	11,727·4	454·16
Senior Two-year-old.						
Rosevale Beauty Posch Griselda	E. H. Watson, Windsor	2 216	272·1	305	12,273·5	468·50
Junior Three-year-old.						
Totara De Kol Nina	Piri Land Co., Auckland	3 117	298·7	305	16,005·9	501·37
Senior Three-year-old.						
Sealands Alcartra Fobes	H. G. A. Cameron, Weraroa	3 304	317·4	305	10,407·8	389·04
Junior Four-year-old.	..	..	..	..		..
Senior Four-year-old.						
Ellerlea Aaggie Segis Minto	C. H. Steadman, Pokapu	4 357	359·2	305	15,311·9	557·71
Mature.						
Ellerlea Egie Segis Minto	C. H. Steadman, Pokapu	6 345	360·0	305	16,303·1	650·85

Friesian Class Averages.

The average production of the eight Friesians gaining certificates during the year was 405·15 lb. fat from 11,422 lb. milk in 299 days.

Ayrshires.

Ayrshire Class Averages.

The average production of the two Ayrshires which gained certificates during the year was 296·59 lb. fat from 6,850·6 lb. milk in 305 days.

We desire to again place on record our appreciation of the co-operation of the Breeders' Associations which are connected with the C.O.R. testing. The success of the work is largely due to their practical assistance.

The Fields Division officer at Dargaville reports that a Matakohe farmer who last year went in extensively for running pigs on the small-paddock system has stated that he is definitely sure that the small-paddock system is not going to be satisfactory from a pasture point of view. In the one year that the pigs have been running in these paddocks rapid pasture-deterioration has taken place. He is trying to overcome this rapid deterioration by removing a number of subdivision fences and making the paddocks larger.

FARMING IN THE AUCKLAND PROVINCE.

OBSERVATIONS ON FARM-MANAGEMENT METHODS.

P. W. SMALLFIELD, Fields Superintendent, Auckland.

III. THE MIDDLE WAIKATO BASIN—*continued*.

THE THAMES VALLEY.

THE Thames Valley, the plains of the Piako and Waihou Rivers, is an area of flat alluvial land lying between the Colville Range on the east and the Maungakawa-Pakaroa-Hangawera-Pateroa Hills on the west; on the north it is bounded by the Firth of the Thames, and in the south by the Tokoroa Plain. The Maungakawa-Pakaroa Hills run from Mount Maungatautari to Morrinsville and divide the plains of the Waikato and Waipa from the plains of the Piako and Waihou; at Morrinsville there is a break in the hills, but they appear six miles to the north as the maturely sculptured Hangawera Hills. The plains consist of low undulating hills, flat areas of light and heavy alluvial soils, and large peat swamps.

Whilst the plains of the Waikato and Waipa were originally settled in comparatively small areas, the Thames Valley was first taken up in large holdings, and many people still remember Matamata, Waharoa, Lockerbie, Paeroa, Mangawhero, Okoroire, Mangapouri, and Waitoa Stations; when these and other stations were controlled by the Assets Realization Board, John McCaw, the general Superintendent, controlled properties having a total area of about 156,000 acres, carrying about 100,000 sheep and 12,000 cattle. It was an age of extensive farming, with short rotation pastures, cereal and root crops, beef cattle, and sheep. Carr Rollett(15) who visited Matamata Estate in 1889, wrote—

> "Matamata at the time of my visit, including Waharoa, about 10,000 acres, part of which had just been leased in small areas to dairy-farmers, totalled 50,000 acres. No less than 22,000 acres were in grass, 2,000 acres in root crops, chiefly swedes and soft turnips, and 500 acres were in oats for threshing and chaffing; the balance was in scrub, fern, and undrained swamps. It carried 31,000 sheep, 2,600 cattle, and 184 horses . Scrub was cut with a mower, the land ploughed, sown in temporary grass, mainly red clover, left down two to three years, then swedes, then pasture for six years, and then swedes, and down to grass for nine years. . . . I saw 20,000 sheep in one mob on 100 acres of turnips. . . . Between 13,000 and 14,000 sheep were driven during the season to Te Aroha and shipped on barges which held 700 to 1,000 Then they were towed down the river, through the Waiheke Channel, up the Tamaki River to Buckland's Farm. . . . Matamata was sold to the State a few years after my visit, the price paid being just under £3 per acre."

Matamata Estate was developed by the late Josiah Clifton Firth, and the Matamata venture must have appealed tremendously to a man of Firth's temperament:—

> "A practical man, an idealist, a romanticist: to go into the wilderness and negotiate with Natives only one generation removed from cannibalism, and still smarting from the sense of the wrongs done them in Taranaki and the Waikato; to convert into a highway of traffic a river choked with obstructions throughout more than half its course; to bring into cultivation more than 40,000 acres of scrub waste, all swampy on its northern flank; to produce wheat enough for his mill and fat bullocks enough for half of old Auckland, and mutton and wool and cheese besides "(16).

Firth's extensive farming failed, as did that of other large stations, and as many have failed subsequently in developing light pumice soils in an extensive way. This land must be farmed intensively, and dairy-farming, with top-dressing and intensive methods of pasture-management, has been successful in turning the great stretch of pumice flats, formed by the Waikato when it entered the basin through the Hinuera Valley, into high-class pasture land.

The Hauraki Plains occupy the northern part of the Thames Valley, between the western hills and the Waihou River on the east, extending south from the Firth of the Thames a distance of about twenty-four miles. Prior to 1908 this large area was a morass, with the exception of a strip of land along the Waihou River. The Hauraki Plains Act, 1908, provided the legal machinery for the drainage and settlement of about 90,000 acres of Crown land. Three types of land were dealt with—viz., (*a*) mangrove flats; (*b*) alluvial flats, covered in raupo and kahikatea, lying between the Piako and Waihou Rivers as far as Kerepeehi, thence by the Awaiti Stream to Netherton; (*c*) peat swamps, with the peat varying in depth from a few inches to forty feet. In draining the area improvements were made to the channel of the Piako River, a drainage channel was constructed to collect the surface run-off from the western hills, stop-banks were erected along the foreshore and rivers to prevent tidal and flood overflows, and an internal system of drainage canals was constructed and the area roaded: the total area covered by the drainage system is 160,000 acres.

Table V.—Crops and Live-stock: Table showing Areas in Crops and Pasture and Numbers of Live-stock in Thames Valley Counties, 1933–34 *

County.	Crops.			Live-stock.			
	Annual Crops.	Pasture.	Pasture cut for Hay and Silage.	Dairy Cows.	Other Cattle.	Sheep Shorn.	Pigs.
	Acres.	Acres.	Acres.				
Hauraki Plains	2,607	79,935	7,815	40,060	16,889	6,117	13,707
Piako ..	6,323	186,865	29,093	91,423	45,119	81,308	31,902
Matamata† ..	10,593	204,687	20,740	70,948	41,638	87,038	28,525
	19,523	471,487	57,648	202,431	103,646	174,463	74,134

* From Agricultural and Pastoral Statistics. † Only the northern portion of the Matamata County is in the Thames Valley; figures are for the whole county.

Farming in the Thames Valley is generally similar to that on the plains of the Waikato and Waipa, dairying and fat-lamb raising are again the chief farming industries; farm-management on the Hauraki Plains presents some particular problems, but these will be discussed in the description of Hauraki Plains County. Piako County is the premier dairying county of New Zealand, for during the 1933–34 season it had 88,546 dairy cows in milk and 2,877 dry dairy cows on the 31st January, 1934, a total of 91,423 dairy cows.

HAURAKI PLAINS COUNTY.

July 16th, 1935: Waitakaruru-Pipiroa-Orongo.—Just before reaching Waitakaruru I examined some recent pasture-sowings on the hills on the western edge of the Hauraki Plains. A manuka covering 5 ft. to 6 ft. high had been cut and burnt, the land disked and sown with a

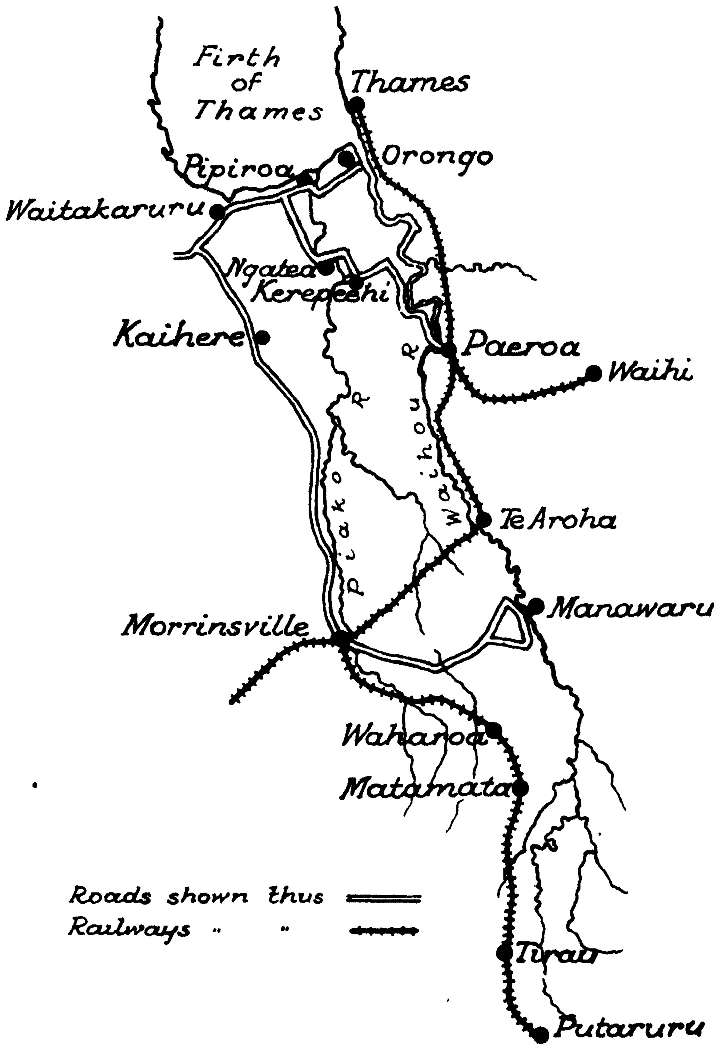

FIG. 6. JOURNEY IN HAURAKI PLAINS, PIAKO, AND MATAMATA COUNTIES.

rye-grass - cocksfoot - white clover mixture. A fair grass and clover establishment had been obtained, but in places the sward was very thin, and manuka and bracken fern were coming back. There are two schools of thought in the preparatory cultivation of this scrub land for grass: some farmers maintain that the land should be ploughed before

grassing and others that surface disking gives the best results. A great deal depends on how the work is done, and really the grassing of these undulating hills should follow fairly closely the system used on the northern gum lands. It is all a matter of seed-bed—a thorough surface disking may give a better seed-bed than bad ploughing and poor after-cultivation, but if the ploughing and subsequent working are well done, and give a firm and moist seed-bed, the results are better than those obtained after surface-disking. Ploughing does away with manuka coming back, and this plant is often a real pest on surface-worked land. With surface working, a good clover establishment is usually obtained, because the seed-bed is firm underneath, but grass establishment is often weak, and with a poor grass establishment only light stocking is possible, and eventually fern and manuka come back. Areas on these western hills are used for winter "run off" country for dairy-farms on the plains, so that during June and July the dry cows can be moved off the wet land of the plains. In the past, heavy winter stocking has done a great deal of harm in poaching the heavy alluvial plains land; to overcome the poaching of the pasture-land in the neighbourhood of the milking-sheds, many farmers have made long, narrow concrete walks running out from the sheds to the various grazing fields—paths just wide enough for one cow to walk on.

The plains are looking particularly well for mid-July. There is a good rye-grass growth on the alluvial land and some small paddocks of prairie-grass are throwing a great deal of feed, but generally the dairy herds do not look as well as they do in other districts on lighter and drier land. Farming on the Hauraki Plains has its own particular problems: the heavy alluvial soils poach badly with winter stocking, and after a wet winter buttercup and pennyroyal are common pasture-weeds; the cows used to scour badly on the peat areas; special supplies of water have had to be provided, as the bore water is mineralized; and grassing has not been particularly successful on some of the littoral clays and deep-peat areas.

The littoral clays, which before stop-banking and drainage grew mangrove woods, occur at the northern end of the plains. Pasture depletion on these areas assumed serious proportions during the dry summer of 1928–29, but had probably been in progress for the previous five or six years. The depleted pastures lost practically all the pasture plants originally sown, and the land reverted to pennyroyal, curled dock, *Poa annua*, and buttercup; the only pasture plants that survived from the original pastures were isolated plants of paspalum, meadow foxtail, patches of *Poa pratensis*, and strawberry clover. The initial stage of deterioration was the dying of white clover, followed by rye-grass and cocksfoot. On some farms the grass went out in patches, on others a single field died out, and on other areas there was a gradual advance of the line of deterioration. During the past dry summer a certain amount of deterioration again occurred, and I visited a farm at Pipiroa where good use is being made of strawberry clover in overcoming the trouble. Where strawberry clover is growing, rye-grass is growing well also, but where strawberry clover is absent, the pastures have deteriorated to *Poa annua* and reversed clover. It is something the same as happens on dry land where white clover goes out, for

without white clover grasses do not flourish. Here on these littoral clays in dry seasons the saline conditions are unfavourable for white clover, hence it dies, but strawberry clover thrives, and with its deep-root system it keeps green in the summer, shades the surface soil, and rye-grass is maintained in a vigorous condition.

Tall fescue still occupies a considerable area of land at Orongo; in the past it has caused great farming difficulties, but areas are now being cleared and sown down in good rye-grass pastures. Cattle sickness is common on tall-fescue country; in the summer and early autumn cattle lose condition, the coat gets rough and the death-rate is high, whilst in the winter lameness is common—a leg, generally the left hind, swells from the hock or knee down, later gangrene sets in, the skin dies above the fetlock, and the foot drops off. On swamp lands that are really properly drained the eradication of tall fescue is not difficult provided the land is reasonably fertile. Drainage is essential, and if the land can be covered with a good sward of mixed grasses and clovers, which are controlled by grazing, tall fescue will not come back. In the eradication of tall fescue the standing growth is generally burnt, the tussocks grubbed and burnt, the land ploughed and sown in an annual crop or temporary pasture, and later sown to permanent grass. Some of the best tall-fescue eradication at Orongo was done by first pulling out the tall-fescue tussocks with a triangular harrow fitted with knife-edges (a road-grader was also used), the heaps of tussocks were burnt, the land ploughed and sown in rape, which was followed by a further rape crop, and the land then sown to permanent grass. At present there are a number of settlers at Orongo using maize as the annual cleaning crop; the land grows good maize crops, and the growing of a cash crop allows of economical fescue eradication. In other places other methods of eradication are used, but generally the best method is ploughing, and the use of annual smother or cleaning crops before the land is finally sown to grass.

July 17th, 1935: Paeroa-Waitakaruru-Kaihere-Patetonga.—A fine day, and the alluvial land along the rivers is everywhere showing a good grass-growth, but on the peat areas the growth is not generally as good. The alluvial soils near the rivers are the best land on the plains, and were covered originally in kahikatea, manuka, cabbage-trees, raupo, or flax, depending on the moisture conditions. At varying distances from the rivers peat overlies the alluvial deposits and varies in depth from a few inches to 40 ft. "Purua grass" (*Scirpus maritimus*) once covered a good deal of the peaty land near the rivers, and is still found in odd places; in the early days it provided much feed, it grows from small tubers and throws a luxuriant summer growth; on the deeper peat areas rushes formed the original covering(17).

In the reclamation of the Hauraki Plains a great deal of stop-banking and river-dredging, as well as drain-cutting, has been done. The channel of the Piako River has been improved, two extensive diversions of the river have been made, and the channel of the river widened. The flooding of the river has not been prevented altogether, but a large area of deep peat to the south of Kaihere is being utilized as a natural ponding-area, and this has the effect of retarding the flood-flow in the lower reaches of the river. The Maukoro Canal constructed from the sea at the mouth of the Waitakaruru Stream collects the water from

the western hills; the Awaiti Canal drains the Awaiti Basin and discharges into the Piako at Kerepeehi; the Ngarua Canal joins the Piako at Kaihere and provides the drainage for a large area of peat land. The stop-bank system commences on the foreshore of the Firth of the Thames and extends up both banks of the Piako as far as Kaihere; in addition, stop-banks have been erected on the Waitakaruru, Maukoro, and Awaiti Canals, as well as round the Kerepeehi Block. The main drains for the removal of internal water have generally an easterly or westerly flow into rivers or canals, and each holding has an outlet drain on one or more of its boundaries. The bulk of these drains have practically an even grade, and if it were not for the range of the tides gravity drainage would be almost impossible. Wherever the drains cross the line of stop-banks automatic flood-gates have been constructed. The deep-peat areas have proved most difficult to reclaim, for loss of level through subsidence of the drained peat has caused large areas to be withheld from settlement.

Visited Mr. A. McClean's farm at Waitakaruru, and watched the dairy herd grazing off a break of pampas-grass. Mr. McClean has for a number of years been experimenting with pampas-grass as a supplementary stock-food, and recently the usefulness of this plant for general feeding has received wide attention. Some quite useful plantations have already been established on some of the poor peat areas of the Waikato, and there is no doubt that the plant has possibilities. No one could watch the cows on Mr. McClean's farm quietly grazing the pampas-plants without being impressed with its potentialities—an actual living fodder for winter feeding(18).

PIAKO COUNTY.

September 6th, 1934: Morrinsville.—A fine day after rain, and the rapid spring growth of grass just starting. The land conditions are generally similar to other parts of the Middle Waikato Basin—low, undulating hills of loams and clay loams, flat areas of silts and loams, and large peat swamps. Feed conditions vary greatly from farm to farm, even on the same class of land. Here a farm with excellent pastures of rye-grass and white clover showing a strong spring growth and having a production in the vicinity of 200 lb. of butterfat per acre, there a farm with bare close-grazed weedy pastures with a butterfat-production of about 100 lb. per acre. The essentials for high production per acre are good and highly productive pastures with good utilization brought about by heavy stocking and careful management. It is interesting to consider just how the increased production per acre from 100 lb. to 200 lb. is obtained. Really it is the application of the old principles of more stock, more manure, and better crops, exemplified in the sayings: "A full bullock-yard and a full fold make a full granary," and "Muck is the mother of money." It is again the application of the principles that brought about the great improvement in British farming in the eighteenth century, when the introduction of the field cultivation of roots, clover, and artificial grasses proved the pivot of agricultural progress. It enabled farmers to carry more and heavier stock; more stock gave more manure; more manure raised larger crops; larger crops supported still larger flocks and herds. These principles apply to grass-farming, and the start of the

upward climb in production is heavy top-dressing to give an increased grass-growth accompanied by increased stocking to utilize the grass and return manure to the soil. The composition of the pasture must be taken into account: for high production, highly producing strains of rye-grass and white clover are required; given these, fertilizers, stock, and management will do the rest. There is no reason why any Waikato dairying land of reasonable fertility should not be producing 175 lb. of butterfat per acre.

Saw a very poor and weedy crop of lucerne sown last spring, which the farmer was intending to try to improve by surface cultivation and by sowing more lucerne-seed. Thin stands cannot be thickened up satisfactorily in this way, and the only feasible method of improvement is to plough up the stand and resow it. Lucerne is established fairly easily on this undulating Waikato land if due attention is paid to essential points in cultivation—manuring, liming, and inoculation. This crop had been sown without inoculation, and the plants, being weak, had been smothered by the luxuriant growth of annual weeds.

August 14th, 1935: Morrinsville to Manawaru.—Grass-growth is excellent in all parts. The winter has been very wet, frosts absent, and grass-growth has continued all through the winter. Visited a 50 acre all-grass dairy-farm at Manawaru on which intensive grassland farming has been practised for a number of years, and the farmer was busy putting on the spring top-dressing of superphosphate. The farm is divided into sixteen fields of 3 acres each, all of which are supplied with water and open on to a central race. Butterfat-production has been as follows:—

Season.	Number of Fields.	Butterfat.	Butterfat per Acre.	Cows.	Super-phosphate.
		lb.	lb.		Tons.
1926–27 ..	8	8,043	161	27	7½
1927–28 ..	10	10,173	203½	32	14
1928–29 ..	13	10,624	212½	37	22½
1929–30 ..	16	11,027	220½	36	14½
1930–31 ..	16	9,605	192	33	15
1931–32 ..	16	8,915	178	35	12½
1932–33 ..	16	10,456	209	35	14
1933–34 ..	16	9,772	195½	33	12
1934–35 ..	16	11,132	222½	40	15

Although there are farms with a higher per-acre production, this farm shows fairly well what can be done with intensive management on a small all-grass dairy-farm. The period covers good seasons and poor seasons, seasons with herd trouble and grass-grub attack, and, finally, the highest production (222½ lb.) per acre occurred in the driest season of all. Briefly, the 50 acre farm has a production of 200 lb. of butterfat per acre from thirty-five cows, each field receives annually from 5 cwt. to 6 cwt. of super, and the whole of the supplementary feed is supplied by harvesting annually 20 acres for hay and silage. Annual crops are often advocated for supplementary feeding, but they are far more costly than the hay and ensilage method of feeding. If the land is ploughed up for cropping it has eventually to be laid down to grass again, and this costs £4 or £5 per acre.

MATAMATA COUNTY.

November 11th, 1934: Waharoa-Matamata-Tirau.—A fine day and farmers everywhere busy with ensilage—there are fields that have been completely ensiled, fields and stacks partly finished, and closed-up fields which are not yet ready to cut. It is remarkable how quickly ensilage has spread throughout the Waikato: prior to 1928 practically no grass silage was made, now it is made on almost all dairy-farms. The importance of ensilage in the Waikato is shown in the following table:—

County.	1933–34.	
	Pasture cut for Hay.	Pasture cut for Ensilage.
	Acres.	Acres.
Waikato	18,565	4,151
Waipa	17,604	7,481
Otorohanga ..	8,934	2,811
Hauraki Plains ..	6,710	1,105
Piako	20,528	8,565
Matamata	17,471	6,269

The great advantages of ensilage are that ensiling can be started in November, is independent of the weather, and fields cut early throw a good aftermath; when pits and trenches are used the ordinary farm labour can get through ensilage without extra assistance.

There are numerous patches of ploughed land being got ready for annual crops, chiefly swedes for winter feeding. The seed-beds are not likely to be particularly good—on some fields there is quite a lot of grass springing up between the furrow slices. In ploughing this light land for roots, a skim-coulter should be used on the plough and the furrow slices rolled before the land is disked: grass competition greatly reduces the yield of swedes.

The northern portion of Matamata County is a dairying district of great importance, and on passing the modern butter-factory at Waharoa one is reminded of the tremendous strides that have been made in the dairy industry in the past thirty years. This factory, to which there are 629 suppliers, for the 1934–35 season produced 4,740 tons of butter and 999 tons of cheese. In 1900 the Waharoa Cheese-factory, owned by the Assets Realization Board, was described as follows:—

"It is a wooden building with an iron roof, is divided into five departments, and the machinery is driven by a three-and-a-half horse-power stationary engine. In the cheesemaking department there are two vats and two presses. There are two storerooms and a large cheese-room for curing. The company has 120 milking cows, and there are in addition ten suppliers who milk in the aggregate about double that number."

Matamata is a large county, and stretches from Waharoa in the north to the Waikato River, near Atiamuri, in the south: on the west it reaches to Mount Maungatautari (2,639 ft.), and on the east to Mount Puwhenua (2,047 ft.). The northern end consists of a plain of pumice

silt which rises gradually in the south to the Tokoroa Plain and thence to the Central Plateau. Northern Matamata County is a very intensive dairy-farming and fat-lamb-raising district, but in the south and east where the land rises to the Central Plateau considerable areas have been planted in *Pinus radiata* forests, which in 1933-34 covered 130,368 acres.

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PULPY KIDNEY OF LAMBS (INFECTIOUS ENTEROTOXAEMIA) AND ALLIED DISEASES.*

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THE NATURE OF ENTEROTOXÆMIC DISEASES.

PULPY-KIDNEY disease of lambs and certain other similar conditions affecting older sheep are due to infectious enterotoxæmia—that is to say, there is a multiplication of certain micro-organisms (hence the term " infectious ") in the intestine. As a consequence, there is produced a very powerful bacterial poison, or toxin, in the lumen of the intestine, which is absorbed into the blood-stream (hence the term " enterotoxæmia ") by means of which it reaches all parts of the body and causes either sudden death or death after a few hours of acute illness.

When a post-mortem examination is made there is found an accumulation of fluid in the heart-sack (pericardium), the organs appear congested with blood, and the kidney substance may or may not be "pulpy." Pulpiness of the kidney is not present at the time of death, but may be found very shortly afterwards. Otherwise there is little to be seen at a post-mortem examination save slight changes which suggest toxæmia. An affected lamb, seen before death, shows symptoms pointing to acute abdominal pain, and is frequently convulsed. It strains painfully and passes soft, gassy fæces that are obviously abnormal.

CAUSE OF PULPY KIDNEY.

It was first suggested in 1928 that pulpy kidney was due to absorption of a bacterial toxin from the gut. In 1930 the first definite proof of this was obtained, and the following year the organism responsible for it was isolated from affected lambs' intestinal contents. Further study of the characters of this microbe, both by the writer in New Zealand and by Oxer in Tasmania, showed that it was identical with one

* Summary of a paper entitled " Infectious Enterotoxæmia and the Clostridium Welchii Group, with special reference to so-called Pulpy Kidney in Lambs, which was read at the 1935 conference of the Royal Society of New Zealand. The full text will be published shortly in the *New Zealand Journal of Science and Technology*.

described by Bennetts in Western Australia in 1932 as the cause of a disease of older sheep, which bore a striking resemblance to pulpy kidney in lambs. Bennetts named his organism *Bacillus ovitoxicus*. This name has now been changed to *Clostridium welchii*, type D, for the reason that it is, actually, a particular type of an already well-known organism called *Clostridium welchii*, of which three other types, known as A, B, and C, were already known.

CAUSAL ORGANISM AND ALLIED TYPES.

This group of organisms—the welchii group comprising types A, B, C, and D— is a complicated one, and there is probably much still to be learnt about it, but it is most interesting and of great importance to human and animal health. The following serves to emphasize its importance. *Bacillus welchii* is a constant inhabitant of the intestinal tract of man and animals, and through the fact that its spores are very resistant to destructive agencies, such as dessication, it may be found almost everywhere (in fæces, soil, dust, surface water, and so on). It first came into prominence during the late war, when it was found to be the common cause of gas gangrene supervening on shrapnel and other wounds. In 1926 a disease of newly born lambs, known as " lamb dysentery," which occurs mainly in the North of England and caused very serious losses, was shown to be due to a germ having all the main characters of *B. welchii* but forming a different and much more powerful toxin. It is now known as *Clostridium welchii*, type B. In 1930 a third type (C) was found to be the cause of a disease of ewes in the Romney Marsh district in Kent. The disease is known to the local shepherds as " struck," and is in the nature of an enterotoxæmia. In 1932, as already stated, Bennetts's work in Western Australia on infectious enterotoxæmia revealed the fourth type (D), and the organisms found to be the cause of pulpy kidney in lambs were subsequently found to belong to that group also. As outlined here, the matter seems quite simple and straightforward, but in reality the inter-relationships of the four types are by no means clear as yet, and it is possible that still other types may be found as research continues.

ECONOMIC BENEFITS FROM THESE RESEARCHES.

The knowledge already obtained has proved of enormous economic value, especially in the control of certain diseases of sheep. Lamb dysentery caused heavy losses in the affected districts, in some flocks as many as 90 per cent. of the lambs dying within a day or two of birth. This loss can be almost completely eliminated by the inoculation of lambs at birth with type B antitoxin, or by vaccinating the pregnant ewes so that the lambs acquire supplies of antitoxin from the ewes' colostrum. " Struck " of ewes in the Romney Marsh may cause the death of from 3 per cent. or 4 per cent. up to 20 per cent. of the ewe flock. From figures lately published it appears that vaccination will eliminate about 75 per cent. of these losses. Infectious enterotoxæmia of sheep and older lambs in Australia due to type D has caused huge losses in flush seasons, not only in Western Australia, but in the other States as well. Vaccination in Western Australia has reduced the losses there by 85 per cent. or better, and sheepowners in affected areas are adopting it as a preventive measure in ever increasing numbers. Recently very suggestive evidence has been obtained that " grass

disease " of horses in Scotland, a highly fatal disease that has taken an appalling toll of equine life in certain parts of Scotland for the past twenty or thirty years, and has lately shown a tendency to crop up in horses farther and farther south into England, is also a form of enterotoxæmia due to *C. welchii*, type D. If these findings are substantiated, there is no apparent reason why this, too, may not be completely controlled in a very short time.

Vaccines and Antitoxin in prevention of Pulpy Kidney in Lambs.

Immediately the nature of the disease and the identity of the microbe causing it were discovered, vaccine and antitoxin supplies were prepared and trials made.

The vaccination of lambs was not a success. The majority of losses occur in lambs about three weeks old, and as for good results with vaccines of this sort, two doses are required with an interval of at least several days between them, the practical difficulties would be almost insuperable even supposing the method proved a success.

Antitoxin, on the other hand, is admirably suited to the prevention of this disease in New Zealand, as it occurs mainly over a period of a few weeks, in any given district, and an injection of antitoxin will confer immediate and strong immunity for a short time such as that. Experiments with antitoxin which have been made in Central Otago may be summarized as follows :—

Among 2,078 inoculated lambs only eight (0·38 per cent.) died of pulpy kidney, whereas among 2,123 control lambs in the same mobs forty-nine (2·3 per cent.) died. These results were obtained in 1932 and 1933 with single doses of antitoxin, the quantity injected varying from 2 c.c. to 5 c.c. Unfortunately antitoxin is costly to prepare, and except in special circumstances its use is not warranted on economic grounds, since the cost of the antitoxin per 100 lambs would exceed the value of the percentage of lambs likely to die of pulpy kidney if untreated.

Vaccination of Ewes suggested as a Means of preventing Pulpy Kidney in Lambs.

Vaccination of young lambs is impracticable and the use of antitoxin is effective but unsound economically. There is, however, another line of attack which may yet prove both practicable and economical. That is the vaccination of the ewes during pregnancy so that the lambs will obtain antitoxin, in the first days of life, from their dam's colostrum (first milk). The grounds for thinking this might be effective were carefully outlined in the paper of which the present article is a brief summary, and a plea was made for the suggestion to be given a trial.* If this method proved effective it should also be economical, as the cost of vaccinating each ewe with the necessary two doses of vaccine should not exceed about 1½d. per head. Moreover, the vaccine used is of a type that could be safely injected by the farmer with very little tuition. Similar vaccine is already bought and used by the farmers themselves in Australia and South Africa.

* Trials were made in Central Otago this past season, and the results, which were highly encouraging, will be published in this *Journal* shortly.

PREVENTIVE MEASURES BASED ON PREDISPOSING FACTORS.

Considerable space is given to evidence regarding the type of lamb and the feed conditions associated with losses from the disease, and the conclusion is arrived at that while, *in the majority of cases*, it is the fast-growing lamb on abundant milk-supply from its dam which succumbs to the disease, cases undoubtedly occur—and from Leslie's observations at Lincoln College they seem to be particularly prevalent in Canterbury—where the reverse is the case, the lambs being of sub-normal birth-weight and growth-rate. The evidence is that sudden changes on to milk-stimulating feed are dangerous. It is not yet clear why these factors should predispose to the disease, but it seems most probable that they cause digestive disturbances in the lamb, which alter the conditions existing inside its intestine and thus provide the causal organism, if present, with a favourable environment in which to grow and produce its toxin.

Preventive measures depending on flock-management must therefore be devised according to the circumstances in which the losses occur. This is obvious, since, if the predisposing factors vary, preventive measures that are effective in one case will be useless in another. For example, where the disease is associated with rapid growth and abundant milk, or a sudden flush of milk-stimulating feed, efforts to reduce the milk-intake by changing to less stimulating feed, yarding, exercise, &c., are indicated, whereas, to take such steps in cases where losses are related to impoverishment of the ewes, low birth-weight and growth-rate will serve only to make matters worse rather than better.

Because the feed factor is so commonly beyond adequate control, in view of the diversity of circumstances under which this disease of lambs may occur, it is considered the more essential that the possibilities as a preventive measure of vaccination of the ewes be thoroughly investigated.

In conclusion, it is pointed out that pulpy kidney disease of lambs is not the only form of enterotoxæmia causing losses in New Zealand. Some evidence was obtained by the writer in 1931 that sudden deaths among hoggets on turnip crops is of a similar nature, and it is highly probable that here, as in Britain and Australia, the same organism is responsible for some of the mortality which occurs in older sheep. If such cases are encountered, as seems inevitable, it is a comfortable reflection that failing other means of prevention there is every reason to be hopeful that vaccination will prove effective.

The paper concludes with a list of thirty-three references quoted in the text.

The losses occasioned to sheep-farmers through parasitism of their flocks is probably greater than from any other cause. Much information regarding the control of parasites in sheep has been disseminated by the Division during recent years, but too much reliance is placed by sheep-farmers on drenching alone, whilst neglecting the adoption of methods of sheep management and feeding, without which lasting results cannot be obtained. The influence of the nutritional aspect of the sheep in combating the effect of parasites is a very vital one, hence the necessity of maintaining lambs on short pasture providing the maximum of nutrition.—*Report, Director, Live-stock Division.*

APPLICATION OF ORCHARD-SPRAYS.

II. THE PORTABLE SPRAYING-SYSTEM.

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IN the earliest methods of portable spraying the spray mixture, together with a hand-operated pump, were carried or wheeled to the orchard trees by man-power. Such methods proved too wasteful of time for large-scale commercial spraying, so that horses were used for pulling a wheeled chassis on which the mixing-tank and pump were mounted. Steam-power for driving the pump was tried in 1894 (Lodeman, 1896), but gave place to petrol-engines in 1900, and these have been used almost exclusively ever since. More recently, increased mobility of the outfit has been obtained by the use of mechanical traction. The same power unit has been used, in some instances, for the dual purpose of hauling the outfit and driving the pump.

PORTABLE SPRAYING-EQUIPMENT.

Pump.—Under New Zealand conditions it is not practicable for more than two men to spray from one outfit. With a volume delivery of 3 gallons per minute at each nozzle (or combination of nozzles) the pump-capacity required for a one-man outfit is approximately 5 gallons per minute, and for a two-man outfit 8 gallons per minute. A working pressure at the pump of approximately 350 lb. per square inch is required for efficient mist production.*

Power Unit.—For driving the pump petrol-engines are invariably employed, 2 brake horse-power being required for the smaller and 3 brake horse-power for the larger outfit.

Mixing-tank.—Wooden tanks, being both light and resistant to corrosion, are usually employed for holding the spray mixture. In recent years, however, the production of corrosion-resistant steel has made possible the use of metal tanks. These have greater durability than wooden tanks and are less subject to leakage.

The maximum capacity of the mixing-tank for a horse-drawn outfit is limited to approximately 150 gallons owing to the difficulty of hauling larger volumes of spray mixture. Where mechanical traction is used larger volumes of spray mixture can be hauled. The maximum efficient size, however, is approximately 250 gallons since the excessive time taken to empty larger tanks may result in deterioration of certain spray combinations—*e.g.*, lead-arsenate and lime-sulphur—with consequent tree-injury.

Haulage Power.—Horses are usually employed for pulling the spray outfit, one or two being used according to the contour of the orchard, condition of the soil, size of the mixing-tank, &c. Spraying efficiency is increased where tractors are used for haulage, since the greater mobility of the outfit reduces the time taken to spray the orchard. However, capital cost and high rate of depreciation limit the use of tractors to large orchards where there is sufficient supplementary work in cultivation, &c., or where contract spraying is undertaken.

* The relationship between pump-capacity, volume delivery at the nozzles, pump speed, &c., has been discussed previously under stationary systems. See this *Journal*, Vol. 52, p. 1.

Water-supply.—The location of the water-supply is important, for if it is not central a large amount of time is spent in travelling to replenish the mixing-tank. Where the supply is not adjacent to the orchard, it is advisable to install an auxiliary pump and pipe-line for driving water to a conveniently situated holding-tank. In large orchards increased efficiency may be obtained by locating such tanks at various points. Holding-tanks should be raised to permit of rapid filling of the mixing-tank by gravitation and should hold sufficient water to provide, with the aid of the auxiliary pump, an uninterrupted supply. Where an ample supply of stream or well water is available holding-tanks are unnecessary, but some method of rapidly filling the mixing-tank is required. For the purpose an attachment known as a self-filler may be used. These fillers are operated by the pump, and will deliver up to 35 gallons per minute, depending on pump capacity and pressure, but will not work efficiently if the water-supply is more than 16 ft. below ground-level.

MANAGEMENT

The usual method adopted with horse-drawn outfits is to spray two rows of trees on either side of the avenue through which the outfit is driven. Hose-lengths of approximately 60 ft. are used, the outfit being moved each time eight trees have been sprayed. With properly trained horses driving can be directed by word of command from one of the nozzlemen without interrupting spraying.

Where the outfit is tractor-drawn a different method is adopted, since frequently moving the outfit results in wastage of time in driving and in increased petrol-consumption by the tractor. Hose-lengths of up to 120 ft. are used and large blocks of trees sprayed, so that the outfit requires to be moved only once before the mixing-tank is emptied. The size and shape of the blocks of trees and the sequence in which the trees are sprayed are similar to those previously described for stationary systems.

A method which is extensively used in America and which has recently been adopted in a few orchards in New Zealand is to spray from platforms on the outfit whilst driving between the rows of trees. By this means the work of spraying is considerably lightened, and it is claimed that time is saved. The principal objection to this method is that where trees are dense or overhanging efficient coverage is difficult to obtain owing to the limited angle from which spray can be applied. Further, in order to save time the volume delivery at the nozzles has to be considerably increased, resulting in a wastage of spray. As it is necessary in this method to drive between each row of trees, consolidation of the orchard soil and damage to trees, cover crops, &c., is more extensive.

Owing to the relatively severe conditions under which portable pumps work, constant attention to release-valves or pressure-regulators, pressure-gauges, &c., is necessary for efficient working. It is advisable to cover the pump and engine with some form of light screen to protect the metal parts from spray-drift. In many cases the horses are also covered during spraying operations. At the completion of each day's spraying the pump should be washed out with water, and the outfit housed in a shed or covered with a waterproof sheet.

COMPARATIVE EFFICIENCY OF PORTABLE AND STATIONARY SYSTEMS.

In recent years there has been a gradual replacement of the portable by the stationary system. The advantages possessed by the latter

are—(1) Spraying is not hindered by adverse soil conditions, and can be completed with a saving in time of 30 per cent. to 40 per cent., thus resulting in greater efficiency in disease-control; (2) damage to cover crops, trees and fruit, and consolidation of the orchard soil is negligible; (3) hill-side orchards can be sprayed more easily; (4) where electric power is available electric motors can be used. These are easier to operate and less subject to mechanical trouble than petrol-engines; (5) running-costs are lower, since haulage power is not required; (6) depreciation of the spray pump and engine, &c., and the cost of repairs and replacement of parts are less; (7) labour-costs are reduced.

The following are the main disadvantages of the stationary as compared with the portable system: (1) Time is wasted where a few varieties requiring particular spray treatment are scattered through the orchard; (2) higher pump-pressure is necessary owing to loss of pressure in the pipes; (3) the capital cost of installation is higher, due mainly to the cost of piping. Depreciation of the piping-system, however, is so low that it may be regarded as a permanent improvement to the orchard; (4) a certain amount of spray is wasted and time spent in washing out the piping-system.

For the majority of orchards greater efficiency can be obtained by the stationary system, the use of the portable system being limited to small areas—up to 5 acres—or to orchards where various spray treatments are required for a number of different varieties.

LITERATURE CITED.

LODEMAN, E. G. (1896): The Spraying of Plants. 399 pp.

VARIETIES OF BARLEY, SEASON 1935-36.

HITHERTO there has been no official information available respecting the extent to which the different varieties of barley have been cultivated in the Dominion. With a view to obtaining some data on the subject, farmers were asked to indicate varieties of barley when furnishing (in September, 1935) their annual returns of wheat, oats, barley, and potatoes sown or intended to be sown for the 1935–36 season.

The first column of figures in the following table shows the areas of the different varieties actually specified in the replies received from growers. The second column of figures shows for each variety of barley the total estimated area for the season 1935–36.

Variety of Barley.	Actual Area specified.	Total Estimated Area, 1935–36.
	Acres.	Acres.
Chevalier	4,989	7,840
Spratt Archer	3,670	5,760
Plumage Archer	1,720	2,700
Goldthorpe Spratt	2,121	3,330
Cape	2,002	3,150
Skinless	1,693	2,660
Other varieties	677	1,060
Totals	16,872	26,500

The first four varieties shown above are malting barleys, the aggregate area being estimated at 19,630 acres. Some of the "other varieties" may come within the malting category, in which case the area quoted would be correspondingly increased. —*Monthly Abstract of Statistics.*

HOW TO FORWARD PATHOLOGICAL SPECIMENS TO THE VETERINARY LABORATORY, WALLACEVILLE.

A CONSIDERABLE amount of trouble arises through packets of specimens or samples posted to the Veterinary Laboratory, Wallaceville, not being securely or sufficiently packed by the senders. These packets are sometimes the cause of other mail matter becoming damaged through leakage from badly packed specimens, and complaints have been received from the Post Office in regard to the objectionable and possibly dangerous nature of the contents of some packets causing such contamination. At times loss of the material submitted for examination results and consequently a report cannot be given on the case.

Therefore, farmers and others utilizing the services of the Veterinary Laboratory in the diagnosis of troubles affecting live-stock particularly are requested to observe the following rules when submitting specimens for examination :—

(1) All specimens or samples, other than milk-samples, when forwarded by post must be sent by either packet-post or by letter-post. *The postal regulations prohibit the use of parcel-post except in the case of milk-samples.*

(2) The rail service may be used if considered more suitable by the sender. Railage must be paid by the consignor.

(3) Every packet posted must be conspicuously marked with the words "*Specimen for examination.*"

(4) The postal regulations require that any such liquid or substance must be enclosed in a receptacle hermetically sealed, or otherwise securely closed, and the receptacle itself must be placed in a strong wooden, leather, or metal case in such a way that it cannot shift about, and with a sufficient quantity of some absorbent material (such as sawdust or cotton-wool) so packed about the receptacle as absolutely to prevent any possible leakage from the package in the event of damage to the receptacle. (Newspaper makes a fairly good absorbent; if at all possible avoid the use of dusty material in packing.) The Post Office may destroy any package not properly packed.

(5) When packing any specimen of a solid nature, such as a dead bird or a piece cut from an organ of any animal, it is advisable to take a piece of clean cloth and place it (the cloth) in a solution of formalin or methylated spirits, then wring it out and wrap round the specimen. This acts as a preservative and prevents the specimen becoming too putrid during transit. The wrapped specimen should then be placed in a strong container, as mentioned in paragraph No. 4 (strong cardboard can be made to serve) with sufficient packing to hold it firmly in place.

(6) A note should be enclosed in the package giving the following information : (i) Date of despatch ; (ii) nature of specimen and particulars of origin ; (iii) purpose for which examination required ; (iv) name and address of sender.

(7) In addition, a letter should be despatched in the first mail giving full details with as complete a history of the case as possible. This enables a proper look-out to be kept for the package in case it is delayed in transit, and at the same time facilitates laboratory examination and report to the sender.

(8) Address postal communications to "Officer in Charge, Veterinary Laboratory, Private Bag to Wallaceville, Wellington."

Parcels consigned by rail should be addressed "Veterinary Laboratory, Wallaceville."

The address for telegrams is "Vetlab, Upper Hutt."

—*Live-stock Division.*

OVERSEAS TRADE.

EXPORTS of merchandise during the calendar year 1935 amounted to £46,538,678, and commodity imports to £36,287,544, so that external trading in commodities during the year resulted in an export surplus of £10,251,134, as compared with £16,003,295 in 1934 and £15,424,553 in 1933. The quantities and declared values of the principal export commodities of farm origin in the calendar years 1934 and 1935 are shown in the following table :—

Item.	Unit of Quantity.	Quantity. 1934.	Quantity. 1935.	Comparison 1935–34 (Increase + or Decrease –).	Value. 1934.	Value. 1935.	Comparison 1935–34 (Increase + or Decrease –).
				Per Cent.	£ (N.Z.)	£ (N.Z.)	Per Cent.
Butter	Cwt.	2,614,519	2,789,298	+ 6·7	10,042,776	13,616,740	+35·6
Casein	Cwt.	57,744	65,167	+12·9	149,666	161,700	+ 8·0
Cheese	Cwt.	1,984,496	1,727,552	−12·9	4,694,459	4,376,512	− 6·8
Frozen beef (including chilled)	Cwt.	827,310	817,586	− 1·2	871,359	979,711	+12·4
Frozen lamb (whole carcasses)	Cwt.	2,584,405	2,605,526	+ 0·8	7,903,337	8,184,521	+ 3·6
Frozen mutton (whole carcasses)	Cwt.	901,938	1,025,305	+13·7	1,595,564	1,837,600	+15·2
Frozen pork	Cwt.	426,426	491,640	+15·3	1,138,488	1,308,222	+14·9
Frozen meats, other ..	Cwt.	229,368	266,457	+16·2	378,207	458,914	+21·3
Meats, potted and tinned	Cwt.	44,348	74,205	+67·3	127,090	216,217	+70·1
Sausage-skins ..	Lb.	4,524,412	4,192,001	− 7·3	625,394	787,261	+25·9
Milk, dried	Lb.	17,493,122	14,578,002	−16·7	338,539	272,382	−19·5
Milk and cream, preserved, &c.	Lb.	4,069,328	6,205,078	+52·5	69,169	98,508	+42·4
Apples, fresh.. ..	Lb.	57,763,643	37,790,819	−34·6	716,780	467,422	−34·9
Pears, fresh	Lb.	4,915,070	3,786,790	−23·0	62,060	57,071	− 8·0
Cattle-hides	Number	476,235	521,745	+ 9·6	439,013	441,325	+ 0·5
Sheep-skins with wool..	Number	2,949,971	2,405,251	−18·5	524,309	381,283	−27·3
Sheep-skins without wool	Number	9,243,726	11,765,293	+27·3	725,782	894,181	+23·2
Wool	Bale	741,916	647,801	−12·7	12,516,425	7,096,873	−43·3
Seeds, grass and clover	Cwt.	48,751	71,649	+47·0	166,511	215,738	+29·6
Tallow	Ton	27,662	25,277	− 8·6	480,354	630,638	+31·3

—*Monthly Abstract of Statistics.*

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 30th January, 1936, to 13th February, 1936, include the following of agricultural interest :—

No. 72599 : Milk claw ; G. E. Harrison. No. 73820 : Seed-stripping apparatus ; A. A. Russell, jun. No. 74041 : Manure-mixing device ; A. C. Anderson. No. 75131 : Plant-raising ; Sprout Ltd. No. 75234 : Sheep-shears ; G. J. Burge. No. 73291 : Milking-machine ; J. Underwood. No. 73356 : Tilling-implement ; F. and H. Petty. No. 73368 : Harrow ; W. B. Anderson and H. C. Russell. No. 73428 : Control of bees in hives ; C. A. Sharp. No. 74129 : Insecticidal composition ; E. I. Du Pont De Nemours and Co.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

SEASONAL NOTES.

THE FARM.

The Cereal Crops.

IN the main grain-growing districts work in connection with the cereal crops is an important if not the main task of this season of the year. Though during recent years cereal-growing has benefited considerably from research, the work in essential features has not changed in that the basic factors in obtaining success continue to be the provision of suitable soil conditions, the carrying-out of appropriate cultivation, the use of varieties adapted to the purpose and circumstances of the case, and the adoption of appropriate means of controlling diseases and pests. In short, advances in cereal-cropping have not given us a short or easy road to success—indeed, it would be unwise to expect such a road.

In wheat-growing a well-drained soil which favours the natural deep-rooting habit of the crop is essential to success. Hence, if portions of paddocks which are to be sown in wheat, and especially in winter wheat, are inclined to be badly drained during the wet season, then practical means of draining such portions should be employed, otherwise wheat on such undrained land is very likely to perish if any considerable wet period occurs. In the cropping-system one of the best places for wheat is after red clover, peas, or tares. Usually these crops leave the ground in a fertile friable condition, so that a good crop may be obtained with a minimum of cultivation and fertilizer. Another favourable cropping order is wheat after rape. After rape, the land is worked easily, is available at the right season, and any manure applied with the rape is likely to be of appreciable benefit to the wheat. Growing wheat on land just ploughed out of pasture frequently is carried out with good results provided the preparatory cultivation is commenced in good time and is thorough. Wheat after potatoes is also usually successful.

Wheat fares best in a fine firm seed-bed. The advisability of firmness sometimes makes it possible to dispense with ploughing after peas or potatoes, it being necessary to precede the wheat merely by two or three diskings. When wheat is to follow pasture, skim-ploughing should be done early in the autumn, and if it has not been done at the time of publication of these notes it should be carried out as soon as possible. After the skimmed furrows have been exposed to weathering for some six or eight weeks, they should be disked and the land then ploughed to the full depth. By this procedure finely pulverized material is placed at the bottom of the full furrow and lumps are brought near the surface, where they may be pulverized by further cultivation. Early cultivation of grassland gives time for the buried sward to decay properly and to enrich the remainder of the soil, on the other hand a buried sward which has not been broken down by decay may prove very detrimental later, especially under dry conditions, by interfering with the rise of moisture from the lower layers of the soil. When wheat follows another cereal the stubble should be disked or grubbed and the land ploughed later to full depth. When wheat follows grass or another cereal there is always danger of grass-grub infestation. For autumn sowing of cereals small clods are an advantage, provided they are on the surface. They give the seedlings shelter during the winter and gradually crumble into a desirable fine loose surface, which is preferable to the setting of a hard surface layer which may readily occur when the surface soil is fine from the outset.

In the main wheat-growing areas of the South Island spring-sowing of wheat should be practised only when circumstances necessitate it. The

ideal sowing-season is autumn and early winter. In the most southerly wheat areas and in the North Island spring sowing is usually most suitable. The standard varieties—Hunter's, Pearl, and Velvet—require autumn or early-winter sowing; Solid Straw Tuscan may be sown in the spring as well as in the autumn and early winter. In the North Island Jumbuck, which dominates, is sown in the spring.

Extensive field experience over a period of years has confirmed thorough investigations in showing that over a wide range of country it proves distinctly profitable to use with wheat 1 cwt. of superphosphate an acre. While the majority of farmers regularly apply this knowledge, it is somewhat surprising that a minority, but nevertheless in the aggregate, a considerable number, of farmers ignore it, and this for no satisfactory reason.

Wheat is subject to certain serious diseases, outstanding features of which are (1) they readily cause heavy loss in the returns from the crops if proper control measures are not employed, and (2) the proper control measures are simple and relatively inexpensive. Further reference to them follows.

Oats to be used for the production of winter and early-spring feed and subsequently to be allowed to develop for grain-production should be sown in April or in early May. The proved kinds of Gartons are the best all-round oat for the South Island. Algerians rightly are popular for the production of green-feed in autumn or spring and for the provision of good chaff. Gartons, which do not stand grazing to the same extent as Algerians, should be fed off once only and that quickly. When barley and Algerian oats are grown primarily for green feed, a series of grazings when the growth is relatively low is preferable to a single feeding-off of tall growth; the series of grazings of short growth avoids undue waste by trampling and provides better balanced and more attractive feed. As a rule autumn-sown oats and barley respond profitably to an application of 1 cwt. to 3 cwt. an acre of fertilizer of which superphosphate is the main constituent.

Control of Cereal Diseases by Simple Seed Treatment.

The modern methods of controlling certain grave diseases of cereals are dealt with in some detail in this *Journal* by J. C. Neill in July, 1934, and by T. A. Sellwood in December, 1935. The treatments being considered control smut of all cereals excepting the loose smuts of wheat and barley, which can be controlled only by the hot-water treatment. The value of the hot-water treatment in this connection has been demonstrated well in Canterbury. Unfortunately it calls for a degree of control of temperatures which is impracticable in ordinary farms. Despite this, a good deal has been accomplished in Canterbury, particularly in barley-growing, as a result of work carried out by the Canterbury Seed Co., Ltd., in co-operation with the Department of Agriculture.

The modern trend in the treatment of seeds of cereals is to replace wet pickles, usually solutions of bluestone or formalin, by various substances in dust form. The main advantages of the dusts are the elimination of the danger of injury to the seeds and the convenience arising from the fact that dusted seed keeps at least as well as untreated seed, so that the treatment may be carried out at any convenient time between harvest and sowing instead of just at the busy time of sowing. Further, dusting of seed obviates reinfection from sacks, &c., between treatment and actual sowing. Against these substantial advantages is to be set a somewhat greater cost which, however, it is considered widely is more than offset by the advantages specified. Full information about the use of the substances and the equipment employed in dusting seed is obtainable from officers of the Fields Division. Prominent among the substances used are the organic-mercury dusts (Ceresan, Agrosan, &c.). These are effective in the control of the smuts of all cereals except the loose smuts of wheat and barley, which,

as already mentioned, may be controlled only by the hot-water treatment. Dusts of copper carbonate and copper oxychloride have proved effective in the treatment of wheat, but not in that of oats and barley.

Treatment of seed with formalin carried out in the approved manner controls smut, but the seed may be damaged seriously if sowing is delayed or if the soil is dry and remains so for a few days after sowing. Further, if the formalin is not used in the approved manner, the treatment may be ineffective or injurious.

Treatment with bluestone (copper sulphate) may be made effective against smut, but commonly it results in injury to germination and a slowing of early growth.

For treating wheat with formalin, 1 pint of commercial formalin should be added to 60 gallons of water, and for treating barley and oats, 1 pint to 40 gallons of water. A popular and convenient method of treatment is to wet the seed thoroughly by sprinkling through a fine nozzle of a watering-can while turning the grain with a shovel on a floor, 1 gallon of the above solution being required for 4 bushels. After thorough mixing the seed should be made into a heap and left over-night covered with sacks soaked in the formalin solution. The sprinkle method may also be adopted in using bluestone, 1 lb. of bluestone being used with 10 gallons of water. Treatment may also be by means of the steeping method.

General Forage Crop Work.

The extensive and considerable rains since Christmas have given an exceptional colour and growth for this time of the year to pastures over wide areas. A point of practical importance is that the unusual appearance of the pastures is likely to prove deceptive as to its bearing on winter and spring feed. Because of the possibility of early cold conditions the growth of grass before winter may not be so great as current appearances seem to promise, and, further, in any case much of the autumn growth may be of a lush immature character lacking the value for winter feeding that attaches to the more mature growth frequently available for winter.

Another point of practical importance is that dairy cows, because of the present conditions, are yielding exceptionally well, and may do so right into early winter. If they do this, they will not build up the bodily reserves which are so often created in the autumn and without which the feeding in winter and early spring will need to be appreciably better than suffices when body reserves are built up in the autumn. Last year parts of Southland illustrated this position in a striking and unfortunate manner. Exceptionally heavy mortality of dairy cows that occurred in certain districts in the spring was correlated with an autumn which was abnormally favourable for butter-fat production. As a result of this the dairy cows entered the winter in lower condition than usual, and so felt later adverse conditions more gravely than would have been the case had they been able to draw on greater bodily reserves. It was significant that in the same districts sheep, which, of course, had not been subjected to the strain of exceptional autumn production, came satisfactorily through the same seasonal conditions that caused such heavy mortality in dairy cows.

Because of the foregoing conditions it is clear that whenever the feed position is at all weak reliance should not be placed upon recent rains, and cropping designed to strengthen the position generally should be pushed on as much as possible along the lines outlined in these notes last month.

For the purpose of building up the maximum supplies of feed for winter and early spring, care should be taken to turn into silage or hay, before frost injury has occurred, any available green maize or millet. Silage should be made in preference to hay if the amount of green material available is not so small as to lead to undue wastage in ensilage.

Autumn work with lucerne at times is of importance. Occasionally, the growth made during the later part of the season is grazed. The trampling necessarily associated with such grazing definitely favours the

entrance of grass; hence in the interests of the lucerne such grazing is usually inadvisable. While circumstances can be imagined in which the interests of the lucerne should be sacrificed, these circumstances are not so common as are the cases in which the interests of the lucerne are endangered. This is especially true of districts of good rainfall, in which grass may become such a strong competitor of lucerne as to prove one of the worst weeds affecting it and in which, because of "flush" of autumn feed on the pastures, the feed obtained by grazing the lucerne in the autumn is seldom acutely needed. In many instances it has been found advantageous to allow several inches of growth on lucerne as it enters the winter. This obviates the drain of the plants which takes place when fresh shoots are produced towards the end of the growing-season, and hence the plants are stronger and so better able to face competition in the spring from winter invaders. Further, the early development of such invaders is also checked by the shading effect of the growth on the lucerne.

Especially in parts of Taranaki lucerne that has become invaded by weeds is at times cultivated in April. The implement used for this practice should be fitted with narrow tines to avoid as much as possible mutilation of the lucerne plants. Cultivation carried out so late as to exclude the possibility of any further considerable growth of the lucerne is frequently followed by an immediate sowing of 1 bushel to the acre of Algerian oats. This practice gives in the spring a heavy growth of well-balanced feed, and in the meantime the development of more permanent plants which would prove serious weeds of lucerne is checked. It is highly desirable to arrange to utilize the spring growth of oats and lucerne for ensilage early in the season: if it is left standing past the stage when early ensilage is possible, it readily may do considerable damage to the lucerne stand as a result of the shading caused by the oats. The autumn sowing of oats with established lucerne has been confined mainly to districts of free soils in which sufficient loose surface material for the satisfactory covering of surface-sown oats is obtainable with the minimum of cultivation. It may be surmised that if much cultivation is necessary for this purpose the lucerne stand is likely to become unduly damaged.

Pasture-management.

Pasture-management, along the lines discussed recently in these notes, is of seasonal importance. It usually is advisable to apply fertilizer early to newly established pastures. The purpose is to avoid any possible deterioration that would arise from low initial fertility: it is usually more profitable by top-dressing to prevent early deterioration than later on to renovate the swards.

—*R. P. Connell, Fields Division, Palmerston North*

THE ORCHARD.

Export of Fruit.

THERE is little doubt that the russeting of fruit has been the major problem of many exporters this season. The difficulties of grading on this account have been intensified. With the large proportion of the crop affected by russeting a great amount of otherwise "Extra Fancy" and "Fancy" grade fruit has gone into the "Good" grade, and quite a considerable proportion in some instances has had to be rejected altogether. A feature of the position has been the extent of rough russet experienced.

The harvesting of the mid-season varieties is almost at a close, and the picking of the later varieties will shortly be commenced. It may be reiterated here that first pickings should be select, that only the larger sizes should be removed, and that the portion of the crop intended for export should be picked at the optimum state of maturity suitable for carriage

to the distant markets. It should also be borne in mind that, with coloured varieties, colour is not necessarily the only guide by which to pick, that a highly coloured crop does not necessarily indicate that picking should be commenced early; and the converse, because the crop is low in colour, that picking should be unduly delayed.

Because of the quantity of fruit that has now passed over the sizing-machines, care should be taken to see that those parts with which the fruit comes into contact are kept clean and free from grease and grit. Following the packing of the more conical varieties, such as Jonathan and Delicious, it frequently happens that the packing of the flatter Sturmer Pippin is done too tightly and too high, and this has been observed to cause fairly extensive bruising. This is a common fault occurring year after year.

Generally, those responsible for the grading of the fruit will have become well grounded in the work, and the maintenance of the required grading standards should not be difficult. Growers should remember their fruit has to be transported to a distant market and sold in competition with fruit of other countries, and an indifferent grade standard is but adversely affecting themselves. It is not just a matter of squeezing it past the Inspector; and yet, unfortunately, there are some not above boasting that they have managed to get this or that low-grade line away. Such a practice does incalculable harm to the good standard and name of New Zealand fruit generally.

Local Markets.

Fruit intended for local cool storage should receive a careful grading, and all fruit showing disease and skin punctures should be culled. Only the higher-grade fruit should be stored, as frequently the realizations for low-grade fruit ex cool store do not exceed the total marketing-costs.

The fruit intended for local marketing should be tree-ripened as far as possible. When it is intended to hold fruit in ordinary shed-storage prior to marketing it should be graded carefully to cull all fruits with skin punctures, as these are liable to decay. The cases of fruit should be stacked on cleats in the coolest possible position, and excessive draught through the shed eliminated to avoid undue wilting. Although somewhat conducive to rots if broken surfaces are to be found, an occasional wetting of the fruit by pouring water over the top of the fruit stack will to a great extent eliminate shrivel, and, if such wetting is carried out judiciously the fruit keeps considerably longer in a fresh condition.

In the harvesting of pears for cool-storage purposes no delay should occur in getting the fruit into store as soon as possible following picking.

General.

A check should now be made of the case material and packing supplies to see that sufficient is on hand to carry through to the finish of the season.

In the packing-sheds all waste fruit should be gathered up and destroyed and not left about in cases to rot.

The removal of points of congestion and other improvements which could be effected to working-conditions in the packing-shed should be attended to now or be noted for attention prior to the commencement of next season.

—*R. G. Hamilton, Orchard Instructor, Hamilton.*

Citrus Culture.

The moist weather experienced this summer will have left the ground in good condition for the sowing of cover crops, which should be done in the early autumn, so that the crops will be ready to plough in at a suitable date later on. The autumn application of fertilizer, superphosphate and carbonate of lime each 3 cwt. per acre, should coincide with the sowing of the lupin or other seed, and thereby stimulate growth of the resultant cover crop. Nitrogen in the form of sulphate of ammonia and nitrate of soda,

at the rate of 2 lb. to 5 lb. each for bearing-trees may be applied at this period, or organic manures such as blood and bone may be applied. Contrary to opinions which have been held, the results of official experiments have shown that the growth produced from applications of nitrogen is not likely to suffer injury by other than severe frosts during the winter and spring. The working of the soil prior to the sowing of the cover crop should always be done so as to make a slight slope away from the base of the tree, as good drainage is essential to the health of the root-systems of all trees. After the very wet season experienced, the ground will greatly benefit by an additional application of lime, which should be sown on the surface of the soil when the ploughing has been completed for the winter.

Brown-rot.—The loss every year from brown-rot is a serious matter, and varies somewhat in severity according to the rainfall. The cutting-away of trailing branches should be undertaken, as the spores developing on the surface of the soil rapidly spread to both the fruit and foliage near the ground. The Bordeaux (3–4–50) spray recommended in the February notes for verrucosis assists in controlling this disease also.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Management of Breeding-stock.

By this time all hens which are intended for use for breeding purposes during the coming season should have been selected, separated from the rest of the flock, and placed on a ration that is not likely to encourage egg-production.

It is a mistake to try to obtain the last few eggs from such birds and expect them to be in the best condition early in the spring to produce eggs containing the maximum amount of fertility and vitality. If hens are forced by heavy, high feeding to lay too late into the autumn it is likely to weaken them, and, as anything that weakens parents has a tendency to affect their offspring, it is a much wiser policy to see that the prospective breeders are given plenty of time to recuperate.

At times some of the best layers continue laying even in spite of the fact that they are being fed on a lighter ration, and such hens should be separated from the rest and fed on a light grain ration for two or three weeks.

Treatment for Parasitic Insects.

All birds should be examined carefully for parasitic insects, and, if necessary, treated. If only a few require to be treated, the dusting of fine powder into the feathers will rid them of body lice. A good dusting mixture can be made up of equal parts of lime, fine dry earth, and sulphur. Where a large number have to be treated, the best method is the application of a small quantity of nicotine sulphate along the perches just before the birds go to roost. It is also desirable to treat hens for internal parasites, which may be done by first starving the birds for about twenty-four hours, then feeding a mash made up of equal parts of pollard and bran, in which has been mixed a teaspoonful of Epsom salts to each three birds, and one teaspoonful of spirits of turpentine to every five birds. The spirits of turpentine should first be mixed with the bran ; the amount of Epsom salts required should be dissolved in hot water, and when it is dissolved thoroughly and the water has become cold, the solution may be used to moisten the bran and pollard. The best results are obtained when the mixture is given cold.

Feeding the Breeders.

The art of feeding breeding-birds is to so feed them that they will be able to recuperate after the heavy laying-season, come quickly through the moult, and be in the best condition to give good fertile hatchable eggs early

in the spring. The more natural the conditions under which the breeding-stock can be kept the better it is, and if a good clean free range can be provided the best results should be secured. Birds for breeding must, however, be fed well yet carefully during the moulting period, for if neglected during that time, trouble, and perhaps losses, may be experienced during the hatching and rearing season.

There is a tendency for hens to put on too much condition when they are not producing, and this must be guarded against, especially in the case of prospective breeders. It is advisable to handle some of the birds from time to time, and if they show signs of getting over-fat, the amount of grain being fed should be slightly reduced, and the litter increased in order to encourage the taking of more exercise.

Most utility poultry-keepers have their own particular system of treating their breeding-birds. The following is a popular and successful system, and is adopted where only limited room is available : As soon as the breeding-hens have been selected, they are separated from the rest of the flock and placed in a house where plenty of litter is provided, and at least 4 square feet of floor-space is allowed per bird. They are kept in the house, and fed on a grain ration which is made up of wheat, maize, and barley (or oats). When the moult is just about over, the birds are then let out into fresh pens, and a mash is fed each day, as well as the grain mixture, this mash being made up of two parts, by measure, of pollard to one of bran, and about 5 per cent. of meat-meal is added. A regular supply of succulent green feed should be given each day.

The Breeding-cockerels.

Where cockerels are being reared for breeding purposes, it is well to keep a close watch on them, and to market any that are not showing sufficient promise before they get too staggy. Nothing equals free range for the growing cockerels, but unfortunately free range is not possible on many plants. However, some poultry-keepers are inclined to overcrowd the cockerels, a practice which does not give them a fair chance, and which also seems to overlook the fact that the male bird is more than half the breeding-pen. Cockerels should not be overcrowded nor fed too much mash or rich food. Everything should be done to build up their vigour and constitution.

The chief characteristics to look for in a good breeding-cockerel are—A good, strong, type, showing plenty of width between the legs, which should be straight, with feet well set ; back of good length and breadth, giving room for the internal organs ; head strong and masculine (a most important point), showing character not too coarse but not too fine ; a good breeding-hen should be fine in head, but it is usually better to see the male a little coarser and with a real masculine look ; comb well set on the head, and following the line of the neck, and of medium size ; eyes keen, bright, and straight. Most of these points apply to all utility breeds, but, of course, due allowance should be made for breed characters.

New Blood.

The poultry-keeper should ever be on the watch for signs which indicate that his flock, or strain, has reached the highest limit in its capacity.

Some poultry-farmers realize that the average size of their birds is becoming too small, that a larger number of the pullets are maturing a little too early, that smaller eggs are being produced, and that perhaps more of the young stock have crooked breasts. Nevertheless, because the average egg-yield from the flock has been better than usual, they are afraid to introduce any new blood.

No doubt there is always a certain amount of risk in introducing new blood, but it is well to remember that, generally speaking, the higher the average egg-production the greater the danger of deterioration, and the

first signs of weakness should be taken as a warning that extra care, or perhaps a slight change in one's breeding methods, is necessary. If the introduction of fresh blood is left too long it may take years to build up the stamina and quality of the flock, and correct any weakness which has been allowed to creep in.

Just how often new blood is required, it is impossible to say, as much depends on individual conditions. Plants have been visited where no fresh blood has been introduced for ten and twelve years, and still the quality, constitution, and productiveness of the flock has been quite satisfactory. These, of course, were exceptional cases, and the owners of such plants were keen, enthusiastic breeders who never sacrificed quality for quantity: only hens above a certain weight were placed in the breeding-pens and the breeding-cockerels were always bred from a few of the best hens of the flock. However, years of visiting many poultry plants and assisting in the selection and mating of breeding-birds, has shown that if the average White Leghorn utility poultry-farmer made it a rule to introduce some fresh blood about every three years it would be to his advantage. As previously mentioned, there is always a certain amount of risk in bringing in new blood, especially with some of the heavy breeds, but it is wiser to risk the temporary loss of some breed characters or maybe a slight reduction in the egg-yield for a season than the more serious loss of stamina.

If proper care is taken to test out the new blood before introducing it through the whole of the home flock, there should not be a great danger in its introduction. Fresh blood may be secured by the purchase or exchange of eggs early in the season. A number of young cockerels may also be secured in the same way, and later on the best kept for testing with some of the best of one's own birds.

A popular way is to purchase a good cockerel about this time of the year, and mate him early in the spring to a few selected hens of the home strain, the best of the progeny from such mating to be then mated through the flock. On the other hand, if the poultry-keeper has a good cock bird that has left good stock, the best way to introduce new blood is to purchase a few good breeding-hens before they moult, and later on mate them with the proved cock bird. If the progeny turn out satisfactory, it usually is quite safe to mate the best of the cockerels with the home flock.

Where it is intended to test out some new blood during the coming season, no time should be lost in placing your order if a good selection is to be had. It is a good idea to look around breeders' plants, in your own district, where a personal selection can be secured, as this may prove more satisfactory than sending a long distance.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Preparations for Winter.

As the honey-flow is now definitely over for the season and extracting finished, the next work will be the preparation of the bees for winter. It is assumed that in most cases sufficient stores have been left in the hives. From 30 lb. to 40 lb. will be required to tide a colony over the winter and early spring.

If sealed combs of honey from clean colonies are not available, colonies that are short of stores should be fed as soon as possible with syrup composed of equal parts of sugar and water. It is better to feed heavily now where necessary, than to wait until the bees have used up their meagre stores. The bees cannot leave their cluster during the cold months of

winter and early spring to take down any syrup that may be offered them, or generate sufficient heat to evaporate any surplus moisture it may contain. It is not commended to feed sugar syrup, but feeding of sugar syrup is advisable in the absence of sealed honey stores, as there is a risk of introducing disease by the feeding of honey unless it is definitely known that the apiary from which it is obtained is quite free from foul-brood and has been so for some years.

It is generally admitted that honey-fed bees have a better constitution than those fed with sugar, and build up better in the spring. There is also reason to believe that some sorts of honey are better than others, but of this we have no definite proof. There is a marked difference in the specific gravity of our honeys.

The entrance of all colonies should now be reduced. The average colony will require an entrance 3 in. to 4 in. wide. If the height is more than $\frac{5}{16}$ in., this should also be reduced in order to prevent mice getting into the hive.

When stacking away the supers of combs for the winter, a sheet of newspaper should be placed between each super and a roof or its equivalent on top, to keep out mice and wax-moths. Any foundation that may be left over should be packed away in a light and air-proof box. It becomes very brittle if left exposed to the atmosphere.

It is advisable to keep a sharp look-out for foul-brood, and, if it is discovered, either to deal with it at once by one of the methods recommended or to destroy the colony. It does not pay to risk the spreading of foul-brood by robbing during the winter.

If robbing sets in, a strip of wood in which an escape has been fitted should be placed across the entrance of the colony that is being robbed, and left there until after sunset. Then the entrance should be reduced to not more than 1 in. in width.

Weak and Queenless Colonies.

As advised last month, queenless colonies should be disposed of by uniting them with strong queen-right colonies. This is most readily accomplished in the evening when all field bees have returned. After taking the roof and mat from the queen-right colony, place a sheet of newspaper immediately over the top of the frames and carefully place the queenless colony on top. No smoke will be required if the hive is handled gently. Weak colonies should be similarly united if the queen is of little value. If the queen is young, brood-rearing will probably be kept up for some time, and such colonies, though weak, will probably be worth saving. This is best accomplished by shifting them into a small hive, called a nucleus box, large enough to take only four frames.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

WITH the commencement of occasional winter frosts towards the end of the month, April is outstanding as the harvest period for many of the main crops, which are used to best advantage when harvested in fine weather and given the necessary storage conditions previously described in these notes. In the absence of ample supplies of well-prepared farm manure, the land which is not required for immediate planting in small fruits or vegetable crops, such as asparagus, rhubarb, and spring cabbage, should be sown down at once in cover crops which make good growth during winter for turning under before replanting in the spring. Land required for planting early crops in the months of July and August should be dressed with such manure

as is available or sown in a quick-growing cover crop such as white mustard, 1 oz. or 2 oz. of seed to the square rod. The remainder of the land may be sown with a legume such as vetches, or dun or partridge field peas, or horse beans, together with oats, or Cape or black barley, 1 lb. of seed of each to the square rod. Such crops should produce good growth for turning under in early spring.

Cabbage-plants, raised from seed sown during the month of February, should now be planted out in dull weather, taking every care to avoid injury and selecting only plants of good type and constitution; they should be set low and planted firmly. Asparagus and rhubarb may be planted out as soon as the plants die back, or it may be done during the month of August. Where the climate is sufficiently warm land may be prepared for sowing peas of a vigorous type, such as Stratagem, during the month of May, when also, in frost-free localities, early potatoes are planted.

The sad havoc among cabbage and cauliflower crops caused in the past by the caterpillar larvæ of the white butterfly has been greatly reduced by the introduction, breeding, and liberation of natural parasites by the Plant Research Station at Palmerston North, but a certain amount of protection is still required by these crops which are now maturing. A dust composed of arsenate of lead powder and hydrated lime, or a spray of the lead powder, has been used with great success, and it is satisfactory during the period the young plants are becoming established. The rough leaves carry a considerable amount of this material after spraying. This not only makes the crop unsuitable for human consumption, but also leaves the supplier liable to prosecution if cabbages are placed on the market in this condition. The difficulty has been overcome to some extent by withholding the spray after the cabbages commenced to heart up and cauliflowers to form a head. A non-poisonous control for this pest has now been discovered in the form of derris dust and sprays. These have been carefully tested in competitive trials under local conditions by the Entomological Section of the Plant Research Station, and the report by W. Cottier published in the January number of this *Journal* shows them to be quite satisfactory, although a little more expensive than the arsenate remedies. They are therefore most suitable for application during the later stages of the growth of these crops at intervals of two or three weeks, as may be necessary. The powder is made from the roots of species of plants known as derris, which grow in the East Indies. Rotenone is one of the active principles of derris, and "the potency of the insecticide is commonly expressed on the basis of the proportion of rotenone it contains," and this to be effective should be 0·5 per cent. to 0·75 per cent. The dust should be applied at the rate of 20 lb. to 25 lb. per acre according to the manufacturers' instructions.

Where grassland is to be broken up for vegetables it should be skim-ploughed now, and some weeks later, when the turf is killed, cross-ploughed deeply, and subsoiled to break up the subsoil without bringing it up to the top. Headlands and corners may have the preparation completed by spade-digging so that all will be ready for planting the hedges and shelter-trees which will be required.

Seeds of cabbage, cauliflower, and lettuce may be sown for planting out in the spring. In cold districts they will later require the protection of a cold frame.

Small and Sundry Fruits.

The planting-season for the hard-wooded crops of small and sundry fruits commences towards the end of May. The preparation of the land should now be completed and plants ordered for delivery as soon as they are ready for lifting. In the home garden the results obtained are often unsatisfactory owing to insufficient consideration being given to the arrangement and situations chosen for the plants. In a situation about the verge of vegetable plots or among other herbaceous plants, the deep digging which

is necessary under the circumstances causes such crops as gooseberries and currants to produce more wood than fruit. Such crops as these are more satisfactory if given an area to themselves so that their requirements may be fully supplied. Deep cultivation, turning under a heavy dressing of manure, and thoroughly cleaning the land of all bad weeds, while growing a vegetable crop, is often the most suitable preparation. If the plants are set about 3 ft. to 4 ft. apart, and 6 ft. between the rows to facilitate access, they will give a good account of themselves if annual pruning and shallow cultivation are given in season. Raspberry-canes may be planted singly 1 ft. apart in the row.

In warmer districts crops of this class are generally best represented by passion-fruit, loganberries, and grape vines on trellises about 9 ft. apart and the plots divided from the rest of the garden by evergreen hedges of guavas or Feijoa, planted at intervals of 2 ft. to 3 ft.

The Chinese gooseberry, *Actinidia chinensis*, is steadily growing in public esteem; its generous crop of egg-shape and size fruit at mid-winter helps to supply variety at that rather lean season. It is a vigorous plant that demands good soil and a large trellis or pergola on which to climb. While it is doing this it should be watched carefully, and all vigorous growth that is badly placed or tends to crowd should be pinched back after a few leaves have formed. If this is done regularly during the growing-period appearance will be enhanced and cropping hastened. In addition to its fruit crop, it is a handsome shade plant which drops its leaves in winter.

In the small home-garden such fruiting-trees as the fig, mulberry, walnut, and persimmon, which are deciduous, and the evergreen avocado, loquat, and citrus plants are often best planted as specimen trees or groups on a lawn, or in its vicinity, where they may well serve an ornamental as well as a useful purpose. The kind of tree to be planted should be decided after careful consideration of local experience, and the position which it is to occupy should be given the same attention, as it probably will be a conspicuous feature that cannot well be removed without detriment.

While most small fruiting-plants have a life of eight to ten years, the strawberry, like most herbaceous plants, requires to be replanted every three or four years to obtain the best results; indeed, in the warmer districts, where it matures rapidly, replanting is done annually when the crop is grown for the market. The same generous preparation as that previously described is quite suitable; indeed, it is usually best to plant strawberries in the same enclosure as the hard-wooded small fruits, so long as the disturbance of replanting does not interfere with the other crops. It is advisable to work in a liberal dressing of blood and bone manure, and then, when the surface has been smoothed out and the land become firm, to set the plants firmly 9 in. to 12 in. apart and 24 in. to 27 in. between the rows. The plants should be chosen with great care, as they should be not only of a good fruiting strain, but of a variety suited to the district, as they are unaccountably fastidious in that respect. In other respects almost any climate or soil here is suitable, after good preparation, so long as it does not dry out in summer. Planting should be done now without further delay, especially in the cooler localities.

The planting of loganberries, tree tomatoes, passion-fruit, and Cape gooseberries is best deferred until the spring.

The Homestead Garden.

New lawns should be cut when the grass is 2 in. or 3 in. high and in dry condition. Cut it as high as the adjustment of the mower permits, as close cutting is detrimental until a good sole of grass has been established. For this work the mower should be well oiled and set carefully: with most kinds of machines this is done by an arrangement which permits the cutting-edge of the bottom blade being raised or depressed. The right

position is that where the revolving cutting cylinder makes an even and firm contact with the bottom blade along its whole length, without jambing. After rain, when the surface is dry, the lawn should be rolled carefully with a light roller weighing about 2 cwt.; on light soils a heavier implement may be used when the grasses are well established.

In most districts the April frosts terminate the display in herbaceous borders. Those borders devoted to annuals should be cleared, and, after a dressing of bonedust has been worked in, planted with spring-flowering bulbs and other herbaceous plants, such as anemones, ranunculus, tulips, hyacinths, wall flowers, primroses, violas, &c., which can be cleared in November for the summer planting. Every third year at this season such a border or bed should be trenched and a good dressing of decayed farm manure worked into the bottom of the trench before replanting. The perennial herbaceous border should be tidied up and given any manurial dressing required. Every third or fourth year at this time of the year it should be cleared completely and reconditioned before replanting. It is advisable to lift one kind and variety of plant at a time and plant out sufficient selected pieces in well-marked nursery rows in the kitchen garden; and when all is clear to trench and manure the border thoroughly, grading the surface carefully. Shallow cultivation should be given afterwards at intervals to destroy seedling weeds, and it is well to take the opportunity to eradicate all bad weeds such as couch-grass, &c. When the ground is settled and clean, replanting may be done when the ground is sufficiently dry. This will be most effective if it is well planned, making the groups of each colour rather large in proportion to the size of the border.

Herbaceous perennials which dislike disturbance may be planted in the shrubbery border where, if the soil and situation are to their liking, they will give a good display in season with very little attention; in fact they thrive best when undisturbed for long periods. They include *Agapanthus umbellatus*, *Amaryllis belladonna*, *A. purpurea (Vallota purpurea)*, pæonies, bluebells (Scillas), and many varieties of lilies and narcissus.

—*W. C. Hyde, Horticulturist, Wellington.*

SEED-WHEAT CERTIFICATION.

CERTIFIED CROPS.

UNDER the Government scheme for the certification of seed wheat the following growers have seed for sale from crops which have passed both field and grain inspections :—

Variety.	Grower.	Acreage.
Cross 7	F. W. Gartery, Springbank, Rangiora ..	20
	Hollis Bros., Mount Hutt, R.M.D., Rakaia	8
	R. B. Paton, Pukeuri, North Otago ..	25
Dreadnought ..	J. Sanson, Kia Ora R.D., Oamaru ..	12
Hunter's II ..	*H. P. Dulieu, R.M.D., Springston ..	9
	*P. J. Dulieu, R.M.D., Springston ..	8
Solid Straw Tuscan	C. Early, R.M.D., Springston	12
	*J. D. Henderson, Halkett, Canterbury ..	10
	Est. C. Smith, Springbank, Rangiora ..	30
	*S. Smith, Box 27, Lincoln	17
	J. S. Thomson, Kirwee, Canterbury ..	37

* Passed subject to machine-dressing of seed.

—*Fields Division.*

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

LICE ON HORSES.

G. M., Taihape :—

Two horses are badly affected by lice. One has been out with a cover on for a while, and the other is a young one which has not worn a cover. Please advise how to clean these horses thoroughly.

The Live-stock Division :—

Lice are especially troublesome in animals that are turned out with a cover on them, as lice breed readily in the warm moist coat under the cover Moreover, when covered continually the skin and hair cannot rid themselves of natural secretions, shed hairs, flakes from the skin-surface, &c., and these provide further encouragement to the lice Animals that are not thriving owing to poor feeding or worm-infestation are also very liable to infestation with lice Grooming and attention to the feed are part of the treatment. Washing the skin with a 2-per-cent. solution of carbolic sheep-dip, Jeyes' fluid, or any similar coal-tar disinfectant destroys the lice, but the eggs are unaffected and hatch out later The treatment to be fully effective must therefore be repeated in from eight to ten days' time.

Before applying the treatment for the first time the animal should be clipped, and the clippings carefully collected and burnt, as they contain many lice and large numbers of nits (eggs). There will also be numerous lice and nits on the underside of the cover that has been on the animal, and this must therefore be well soaked in the above solution, then washed out and dried

EFFECT OF COLD ON BLUE LUPINS.

F. W. G. R., Springfield :-

Is this district, 1,600 ft. above sea-level, suitable for growing blue lupins ?

The Fields Division :—

It is doubtful if lupins would survive an average winter at an altitude of 1,600 ft. above sea-level The blue lupin is generally considered to be a winter hardy plant, but experiences in Canterbury at comparatively low levels indicate that fully grown crops of lupins may be destroyed completely by frost following rain or snow.

Several cases of winter killing were experienced by farmers on the plains this season, following the snow which fell in June, and a number of crops died during the previous winter when frost followed rain. Most of the crops affected were fully grown, and apart from late-sown autumn crops, which may not be sufficiently far advanced to withstand early frosts, this stage of growth appears to be the one at which lupins are most susceptible to frost injury.

HERNIA OF HORSE.

R. H. T. C., Kurow :—

A thoroughbred horse, four years old, has a bulge on its navel about 1 in. thick and 1½ in. long. Can it be removed, and, if so, how ?

The Live-stock Division :—

From the description, the horse probably has a small umbilixal hernia, which has most likely been there since birth. It is a small sac composed of skin, fibrous tissue, and peritoneum ; in this there may be a small portion of bowel.

In foals such a small hernia frequently disappears spontaneously, but this does not occur readily in older animals. However, in a hernia of this kind it may not be necessary to do anything at all unless there was a tendency for it to enlarge, or if the animal suffered any inconvenience such as colicky pains

The swelling can be obliterated by a comparatively simple operation, for which the services of a veterinary practitioner are required.

TREATMENT FOR TUTU-POISONING.

M. C. H., Otaki Railway :—

Could you advise me what to do to animals caught in the early stages of tutu-poisoning ?

The Live-stock Division :—

It is often very difficult to apply medicinal treatment to animals suffering from tutu-poisoning, seeing that the trouble causes more or less severe brain symptoms, which renders the animal difficult to handle. Very useful treatment for this trouble, when it can be applied, is the internal administration of ordinary liquid ammonia, or carbonate of ammonia, mixed with milk or thin gruel; in addition, a large dose of linseed oil, not less than 1 quart, should be given. The dose of ordinary liquid ammonia should be 1 oz. in a quart of milk or gruel, or it may be mixed with the quart of linseed oil. If carbonate of ammonia be used the dose is 1½ oz. mixed as above.

DRENCHING SHEEP.

M. A. N., Hangaroa :—

What are the quantities of Black Leaf 40 and bluestone used as a dose for sheep, lambs, hoggets, &c. ?

The Live-stock Division :—

The quantities of bluestone and Black Leaf 40 for use in drenching sheep for stomach worms are as follows : Dissolve 1 lb. of bluestone in 5 gallons of soft water, then stir in 16 oz. of Black Leaf 40. The bluestone solution must not be prepared in a metal vessel ; it is necessary to use either wood, earthenware, or enamel-ware. In the latter case the enamel must be intact, as even a small flaw which exposes the metal underneath will destroy the value of the bluestone-solution. The doses of the above mixture for sheep are as follows : Small and weakly lambs, ¼ oz. with ¼ oz. water added to it ; strong lambs, ½ oz. ; hoggets and older sheep, 1 oz. to 1½ oz.

BLOW-FLIES ATTACKING SHEEP.

V. L. J., Ngaruawahia :—

What are the best measures to minimize the trouble and loss caused by blow-flies attacking lambs ?

The Live-stock Division :—

The blow-fly chiefly concerned is the golden haired blow-fly and the small green bottle-fly. The maggots of the latter soon penetrate the skin of the sheep and burrow deeply into the muscles if not discovered and dealt with in time. As an important preventive measure the flocks in which the trouble has appeared or is likely to appear should be properly dipped in a powder arsenical dip, and if there is a fair growth of wool on the sheep the protection afforded by dipping should continue for a considerable time. Before dipping, the sheep should be dagged and thereafter kept clean. Another preventive measure is to see that all dead sheep are buried or burned. When a sheep is observed to be blown, all dirty or matted wool should be removed by the shears and a solution of non-poisonous fluid dip applied to the part ; or a very good dressing is one part oil of turpentine to three parts of olive oil. The greatest care should be taken to see that all the maggots are destroyed, as when the wool is being removed they immediately try to bury themselves amongst the surrounding wool. It is advisable therefore to examine dressed animals on subsequent days. Sheep in exposed areas are not so liable to attack as those in sheltered valleys or in the vicinity of bush or plantations. A fly-trap may be made out of a kerosene or petrol tin. Cut the top out of the tin, put a skinned rabbit in it, with two quarts of water, cover tightly with wire gauze and thrust the narrow end of a good-sized funnel through the centre of the gauze, and place in a sheltered position.

WEATHER RECORDS: FERBUARY, 1936.

Dominion Meteorological Office.

NOTES FOR FEBRUARY.

FEBRUARY is usually a dry month, but this year not only did we have by far the wettest February hitherto recorded in New Zealand, but, except for the western and southern portions of the South Island, it is doubtful whether even in a winter month so much rain has fallen over the country as a whole. Flooding occurred at times over practically the whole of the North Island, and in parts of the Auckland Province the floods of the 1st to 2nd were of record proportions. In South Marlborough, Canterbury, and north-eastern Otago also there was heavy flooding. In Canterbury the floods of the 19th to 21st were the most severe since 1923, and the Ashley River rose to unprecedented heights. In consequence of the wet weather there has everywhere been a rank growth of pasture. Stock are in good condition generally, and the milk-yield has been well maintained. For sheep the grass is too rank and soft, and lambs are not fattening well. Severe damage has been done to the wheat crop, which otherwise would have been excellent. In many cases grain, both standing and in stooks, has sprouted Conditions have been extremely unfavourable for haymaking The apple crop, however, appears to be satisfactory.

Rainfall.—Over the whole of the North Island extremely wet weather prevailed, and the totals were generally about three to four times the average for February, though in places with a westerly aspect conditions were, relatively, not quite so bad as elsewhere. In Marlborough, most of Canterbury and eastern Otago, similar conditions prevailed Most of Westland, the Mackenzie County, the interior of Otago, and Southland had less than the average rain. In south Westland there were some heavy falls.

Temperatures.—In most cases the mean temperatures were below normal, but there were frequent exceptions to this rule. On the West Coast means were generally above the average. Marlborough and most of Canterbury experienced a cold month, the departures from normal being approximately 2° F Few frosts were reported.

Sunshine.—Generally the amount of sunshine was well below the average, deficiencies of 40 to 50 hours being common It was the absence of sunshine and consequent low maximum temperatures which was principally responsible for the low mean temperatures for the month

Storm Systems.—During the night of the 1st and the morning of the 2nd a deep cyclone which had originated some days before as a tropical cyclone to the north-west of the New Hebrides, rapidly increasing its speed of movement, travelled down the western side of the Auckland Peninsula, and thence across the centre of the North Island and away in a south-easterly direction In most of the Auckland Province north-easterly gales were followed, after the centre passed, by south-westerly. Elsewhere over the North Island southerly or south-easterly gales were experienced Though short-lived, owing to the rapid movement of the storm, these winds rose to whole gale force in some exposed positions It was probably the most violent storm ever experienced at most places in the North Island, and certainly caused more destruction than any previous one. Extremely heavy rains occurred, falls of 4 in to 11 in. being the rule Though there were some heavy rainfalls, principally in Marlborough, the South Island was little affected.

The remaining storms were rather complex in structure, and none was severe until the centre had passed New Zealand, although heavy rains were produced. On the 7th to 8th there were southerly gales, the temperature dropped sharply; snow fell on the ranges of the South Island; and there were many violent thunder and hail storms. Rain was practically general, and in many places heavy. Canterbury had heavy rains on this occasion.

Another very wet period was from the 17th to the 22nd, rainfall being very heavy, especially in Canterbury, where there was severe flooding and much damage done.

A depression which passed on the 25th deepened when to the eastward, and was followed by a severe southerly gale Again there was heavy rain at many places.

RAINFALL FOR FEBRUARY, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average February Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
North Island.						
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	6·11	11	4·56	3·50	18·19	7·44
Russell	13·58	7	11·84	2·99	37·59	6·24
Whangarei	13·74	15	11·41	3·87	23·19	7·80
Auckland	9·27	10	6·38	3·57	16·16	6·54
Hamilton	9·06	16	3·48	2·91	16·00	6·48
Rotorua	12·17	14	5·27	3·84	22·99	7·95
Kawhia	7·55	10	2·69	2·86	13·16	6·41
New Plymouth ..	6·29	16	2·83	3·94	14·73	8·12
Riversdale, Inglewood ..	11·77	17	5·89	6·03	24·13	13·54
Whangamomona ..	7·46	13	4·51	3·89	15·41	9·47
Hawera	8·53	16	2·50	2·40	12·10	5·91
Tairua	11·94	12	7·91	4·68	18·72	8·34
Tauranga	13·52	15	6·28	3·78	17·90	7·81
Maraehako Station, Opotiki	8·57	10	2·17	4·14	19·07	7·73
Gisborne	10·86	10	3·02	3·46	15·22	6·18
Taupo	9·36	14	3·50	2·74	17·43	6·11
Napier	11·93	12	4·43	2·46	17·06	4·96
Hastings	11·32	10	4·81	2·25	16·02	4·18
Whakarara Station ..	14·22	8	5·45	..	21·74	..
Taihape	10·85	15	2·57	2·43	15·50	5·59
Masterton	11·32	11	2·52	2·78	14·96	5·34
Patea	8·17	16	3·92	2·40	12·00	5·99
Wanganui	8·52	14	4·44	2·42	12·22	5·25
Foxton	8·06	13	2·85	2·07	11·78	4·21
Wellington	9·90	14	2·67	2·75	13·24	5·64
South Island.						
Westport	3·97	11	1·04	5·35	6·94	13·55
Greymouth	3·58	14	0·83	6·21	9·19	15·38
Hokitika	4·44	11	1·72	7·22	8·23	17·32
Ross	6·28	9	2·33	8·90	9·92	21·30
Arthur's Pass ..	..	..	..	9·90	..	24·02
Okuru, South Westland	17·05	7	10·06	9·66	24·57	22·25
Collingwood	6·36	10	1·65	5·13	17·13	11·71
Nelson	3·68	10	0·71	2·63	6·72	5·53
Spring Creek, Blenheim	6·00	12	1·45	2·18	7·92	4·40
Seddon	5·91	11	1·92	1·85	8·52	3·69
Hanmer Springs ..	16·07	14	5·01	3·26	17·58	7·21
Highfield, Waiau ..	14·74	11	5·08	2·60	15·58	5·58
Gore Bay	9·81	13	3·36	2·80	10·84	5·26
Christchurch	6·93	11	2·60	1·56	8·18	3·89
Timaru	8·39	11	5·79	1·79	9·94	4·18
Lambrook Station, Fairlie	5·13	10	2·62	1·81	6·30	4·24
Benmore Station, Clear-burn	1·28	13	0·38	1·62	2·64	4·39
Oamaru	6·80	13	3·15	1·79	9·36	3·83
Queenstown	1·36	11	0·94	1·97	3·96	4·84
Clyde	0·73	8	0·32	1·06	1·61	2·91
Dunedin	8·53	17	2·40	2·71	10·09	6·12
Wendon	2·54	13	1·03	2·26	4·17	5·46
Balclutha	2·04	9	0·82	1·99	2·66	4·30
Invercargill	2·33	15	0·80	3·18	6·44	7·18
Puysegur Point ..	3·89	13	0·97	5·74	11·74	13·36
Half-moon Bay ..	1·32	11	..	4·08	4·48	8·90

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WHEAT-VARIETY TRIALS IN THE SOUTH ISLAND: SEASON 1934-35.

Fields Division, Department of Agriculture.

IN the 1934-35 season wheat-variety trials were laid down by the Fields Division in collaboration with the Wheat Research Institute on twenty-nine farms in the South Island. Unfortunately, seasonal conditions prevented weights being obtained from seven of the experiments, lodging being the cause in most cases.

VARIETIES UNDER TRIAL.

In all the experiments Solid Straw Tuscan was taken as the standard variety with which the others were compared.

Cross 7.—The results of extended trials with Cross 7 in the 1933-34 season (1 and 2) showed the general superiority in milling and baking qualities of this variety over Solid Straw Tuscan, although the latter was slighly better in yield on the average. In order to get more information, particularly in regard to certain localities, further trials with Cross 7 were sown in the 1934-35 season, and fifteen of these were harvested.

Marquis.—In view of the popularity of this variety in Marlborough, and the need of getting some information on its performance, Marquis was included in three trials in that district.

Jumbuck.—In previous years attempts had been made in Canterbury to carry out trials with Jumbuck, a variety which has met with success as a spring-sown wheat in the North Island. Through various causes experiments were not harvested until 1933-34, when two trials were successfully completed. In one of these (in Canterbury) Jumbuck was equal to Tuscan in yield, and in the other (in Otago) it was outyielded by Tuscan. Two experiments comparing these varieties were sown in the spring of 1934 in Canterbury.

Portuguese Varieties: S/617 and S/668.—In preliminary spring-sown trials conducted in Otago and Southland, two Portuguese varieties, which had been picked out by the Wheat Research Institute as promising lines from a number of imported varieties, yielded well. They were therefore included in one trial at Morven in the 1934-35 season and were also sown in a trial carried out by the Wheat Research Institute at Lincoln College.

Other Varieties.—Selections of Solid Straw Tuscan supplied by the Agronomist and crosses originating from the Wheat Research Institute were under trial, but, as this was in the nature of preliminary work, the results are not recorded in this report.

METHOD OF CONDUCTING EXPERIMENTS.

The Beaven half-drill strip method was used in nearly all the trials, and ten replications of each variety were sown. A standard rate of seeding of 2 bushels per acre for each variety was generally adopted, and in all cases 1 cwt. of superphosphate was sown with the seed. Harvesting was usually carried out when the later-ripening varieties in the trial were in fit condition. At harvest samples of each variety were collected and sent to the Wheat Research Institute for milling and baking tests.

RESULTS OF TRIALS INCLUDING CROSS 7.

Particulars of dates of sowing and harvesting and results of each individual trial harvested in 1935 are given in Table 1. Observations during the growing period indicated that Cross 7 generally ripened a few days earlier than Tuscan. In spite of heavy nor-west winds in one or two cases, Cross 7 showed no tendency to shake in spite of being dead-ripe. In several trials Tuscan lodged fairly badly, whereas no lodging occurred in the Cross 7 plots. As some of the experiments where lodging took place could not be harvested, the figures in Table 1 do not include at least three trials in which Cross 7 would have undoubtedly outyielded Tuscan had it been possible to harvest and weigh the plots.

Table 1.—Yield in Bushels per Acre and Differences from Solid Straw Tuscan in Trials with Cross 7.

Location of Trial.	Date sown.	Date harvested.	Yield in Bushels Per Acre. Cross 7.	Tuscan.	Difference in Favour of Tuscan (+) or Cross 7 (−).
Marlborough.					
M. Walsh, Omaka ..	17/5/34	28/12/34	34·5	29·7	− 4·8†
Smith Bros., Tua Marina	26/5/34	3/1/35	33·4	28·6	− 4·8†
F. F. Mills, Grovetown ..	12/6/34	5/1/35	28·1	16·7	−11·4†
Canterbury.					
G. H. Cross, Oxford ..	31/5/34	12/1/35	13·7	14·9	**+1·2**
H. Tallot, Cust ..	6/7/34	21/1/35	12·5	12·4	−0·1
Canterbury Seed Co., Leeston	5/9/34	1/2/35	34·7	33·1	−1·6
G. C. Warren, Darfield ..	1/8/34	14/1/35	16·2	17·2	+1·0
R. Ruddenclau, Lyndhurst	29/6/34	22/1/35	21·9	27·3	+5·4†
D. Spence, Sherwood ..	27/6/34	15/1/35	14·0	13·7	−0·3
C. Campion, Highbank ..	19/6/34	22/1/35	25·9	26·0	+0·1
J. Ruddenclau, Methven..	13/7/34	23/1/35	18·6	21·1	**+2·5**
Campbell Bros., Kingsdown	11/8/34	1/2/35	24·0	26·7	**+2·7**
Lincoln College* ...	..	..	51·4	50·7	−0·7
North Otago.					
B. G. Porter, Tokaraki ..	30/5/34	9/2/35	33·0	34·9	+1·9
W. Stevenson, Incholme ..	25/5/34	17/1/35	31·0	34·2	**+3·2**
D. M. Borrie, Papakaio ..	31/5/34	21/1/35	42·3	44·0	+1·7

* Trial carried out by Wheat Research Institute at Lincoln College included for purposes of record.

† Plots not threshed separately so that statistical examination was not possible. The magnitude of these differences, together with observations prior to cutting, indicated, however, that they were all real.

NOTE.—Differences in heavy type are statistically significant.

COMMENTS ON TABLE 1.

Out of the sixteen experiments five gave significant or real differences in favour of Solid Straw Tuscan and three in favour of Cross 7. As the latter all occurred in Marlborough, it would seem that Cross 7 has a definite place in the latter district, particularly since in the previous season a large difference in favour of Cross 7 was recorded in one experiment. Although the performance of Cross 7 in Canterbury and North Otago is not as good as in the 1933–34 season, in at least three trials from which yields could not be secured Cross 7 would almost certainly have given higher yields than Tuscan, and there is no doubt that under conditions conclusive to lodging Cross 7 will show to advantage. As in previous seasons the milling and baking qualities of Cross 7 were generally higher than those of Tuscan.

RESULTS OF OTHER-VARIETY TRIALS.

The yields of Marquis, Jumbuck, and the Portuguese varieties are shown in Table 2.

Table 2.—Yield in Bushels per Acre and Differences of Miscellaneous Varieties from Solid Straw Tuscan.

Location of Trial.	Variety.	Date sown.	Date harvested.	Bushels per Acre.	
				Yield of Variety.	Difference in Favour of Tuscan(+) or Variety(−).
M. Walsh, Omaka ..	Marquis ..	17/5/34	28/12/34	25·4	+3·8*
Smith Bros., Tua Marina	Marquis ..	26/5/34	3/1/35	38·9	−5·0*
F. Mills, Grovetown ..	Marquis ..	12/6/34	5/1/35	23·1	−6·6*
Canterbury Seed Co., Leeston	Jumbuck ..	5/9/34	1/2/35	33·4	**−5·8**
J. C. Hay, Morven ..	Jumbuck ..	18/9/34	26/1/35	15·3	**+9·3**
J. C. Hay, Morven ..	Portuguese 617	18/9/34	26/1/35	26·2	**−2·1**
J. C. Hay, Morven ..	Portuguese 668	18/9/34	26/1/35	28·0	**−4·5**
Lincoln College ..	Portuguese 617	Autumn	..	57·5	**−5·9**
Lincoln College ..	Portuguese 668	Autumn	..	61·4	**−10·4**

* Yields not examined statistically.

COMMENTS ON TABLE 2.

The good results from Marquis in two of the experiments in Marlborough, especially in view of its reputation as a high-quality wheat, support the preference shown towards it by many growers in the province.

Jumbuck was significantly higher in yield than Tuscan at Leeston, but was significantly lower at Morven In the present season two trials, in which Jumbuck is included, are being conducted in the latter district.

The Portuguese varieties proved successful at Lincoln (autumn-sown) and at Morven (spring-sown). In both trials the baking scores were much higher than those of Tuscan. As there is need of a variety suitable for spring-sowing in Canterbury and Otago,

the performance of these Portuguese lines is very gratifying, and they have been included in several spring-sown trials during the present season.

ACKNOWLEDGMENTS.

The valuable co-operation of those farmers who provided land and facilities for carrying out the trials is gratefully acknowledged. The field work was ably carried out by the following officers of the Fields Division: Instructors A. G. Elliott, Marlborough, H. de O. Chamberlain, Christchurch, E. M. Bates, Ashburton, and W. C. Stafford, Timaru, under the direction of Mr. R. McGillivray, Fields Superintendent, Christchurch, and by Instructor T. A. Sellwood, Oamaru, under the direction of Mr. J. M. Smith, Fields Superintendent, Dunedin.

—*J. W. Woodcock, Crop Experimentalist.*

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FARMING IN THE AUCKLAND PROVINCE.

OBSERVATIONS ON FARM-MANAGEMENT METHODS.

P. W. SMALLFIELD, Fields Superintendent, Auckland.

IV. THE BAY OF PLENTY.

THE farming-areas of the Bay of Plenty consist on the west of a narrow coastal plain and hills rising to the edge of the Central Plateau; towards the east the plain ends and is succeeded by broken greywacke hill country, being the spurs of the Raukumara Range. The coastal plain consists of rolling hills and plains of sands and silts merging into peat and alluvial swamps which lie behind the coastal sand-drifts; the Rangitaiki Plains lie between the Tarawera and Rangitaiki Rivers in the middle portion of the Bay.

The climate of the Bay of Plenty is warm and humid; the mean annual rainfall is 50 in.; the winter is mild, the summer warm, and conditions are very suitable for maize-growing, and, as Arthur Young observed, "the proof of a *good climate* is that Indian corn (maize) comes to perfection in it."

*Table VI.—Crops and Live-stock: Table showing Areas in Crops and Pasture and Numbers of Live-stock in Bay of Plenty Counties, 1933–34.**

County.	Crops.			Live-stock.			
	Annual Crops.	Pasture.	Pasture cut for Hay and Silage.	Dairy Cows.	Other Cattle.	Sheep Shorn.	Pigs.
	Acres.	Acres.	Acres.				
Tauranga ..	4,663	128,916	14,939	51,073	31,590	17,339	20,715
Whakatane ..	4,523	129,567	11,354	44,446	27,325	52,251	20,298
Opotiki† ..	1,178	125,475	4,703	19,162	17,399	92,782	8,257
	10,364	383,958	30,996	114,681	76,314	162,372	49,270

* From Agricultural and Pastoral statistics. † Opotiki County is in the Gisborne Land District.

Farming consists of dairy-farming, fat-lamb raising, and cattle-fattening on the coastal plains, and the grazing of Romney sheep and beef cattle on the surface-sown hill country at the eastern end of the Bay. Citrus-growing is becoming an important industry in Tauranga County, where there were 351 acres in bearing and 172 acres in non-bearing orchards in the 1933–34 season. Maize-growing is an important industry, although the acreage under this crop is not as great as it was once: fifteen years ago fully 8,000 acres were grown, but now the acreage is only 3,000. For the past three seasons maize-production for grain has been as follows:—

Season.	Counties.		
	Tauranga.	Whakatane.	Opotiki.
	Acres.	Acres.	Acres.
1931–32	1,330	1,316	539
1932–33	1,636	1,590	681
1933–34	1,579	1,704	597

The production of maize has encouraged the development of profitable side-lines—poultry-farming, and pork and bacon production—to dairying. Maize is not a complete food for stock-feeding: it is low in protein and its proteins are unbalanced, but it can be produced cheaply, and its extended production would facilitate the expansion of the pork and bacon industry. In bacon-production in the Bay, maize is largely fed to autumn litters through the winter, the pigs are carried forward into the spring in a thriving condition, and are finished off in the spring on skim-milk.

Maize is a wonderful cereal; it has been described by Cobbett as "the choicest gift of God to man in the way of food." and more use could be made of the crop in all the warmer parts of the Auckland Province. In the Bay of Plenty maize is grown on both the rich flat alluvial soils and lighter hill and terrace country; on the flats a crop of swedes is usually taken after grass, and then follow one, two, or three crops of maize for grain, after which the land is resown to grass; on the light hill and terrace land maize always follows grass, and usually only one or two crops are taken before the land is resown to pasture. On areas where frosts are experienced in the late spring and autumn, rapidly maturing varieties are grown—Early Butler, Early Morn, and Funk's Yellow Dent. On rich land, with late varieties, yields of 80 bushels are obtained, whilst the early varieties seldom produce more than 50 bushels. Maize is sown from about the 20th of October to the 10th of November, with a maize-planter, in rows 3 ft. apart with the plants spaced about 1 ft. apart in the rows; 14 lb. of seed are sown per acre, with usually 2 cwt. of phosphatic fertilizers. The crop is intercultivated four or five times, commencing when the plants are 4 in. to 5 in. high, and repeated fortnightly until the crop is too high for intercultivation. The early varieties mature in four and a half to five and a half months whilst the late varieties take six and a half to seven months. After harvesting, the maize is stored in a crib for a month to six weeks before shelling(19). The grain is largely used for feeding poultry and pigs along with skim-milk, and, with the help of maize, many Bay of Plenty dairy-farmers are securing a net return of 3d. per pound butterfat from pork and bacon.

TAURANGA COUNTY.

August 6th, 1934: Athenree to Te Puke.—The high fern-clad hills that surround the Waihi Plains give place at Athenree to low rounded downs, and flat-topped spurs sprawl out into the shallow Tauranga Harbour. Athenree was one of the homesteads of the Katikati Settlement of 1878, made under the Auckland Waste Lands Act, 1874, which

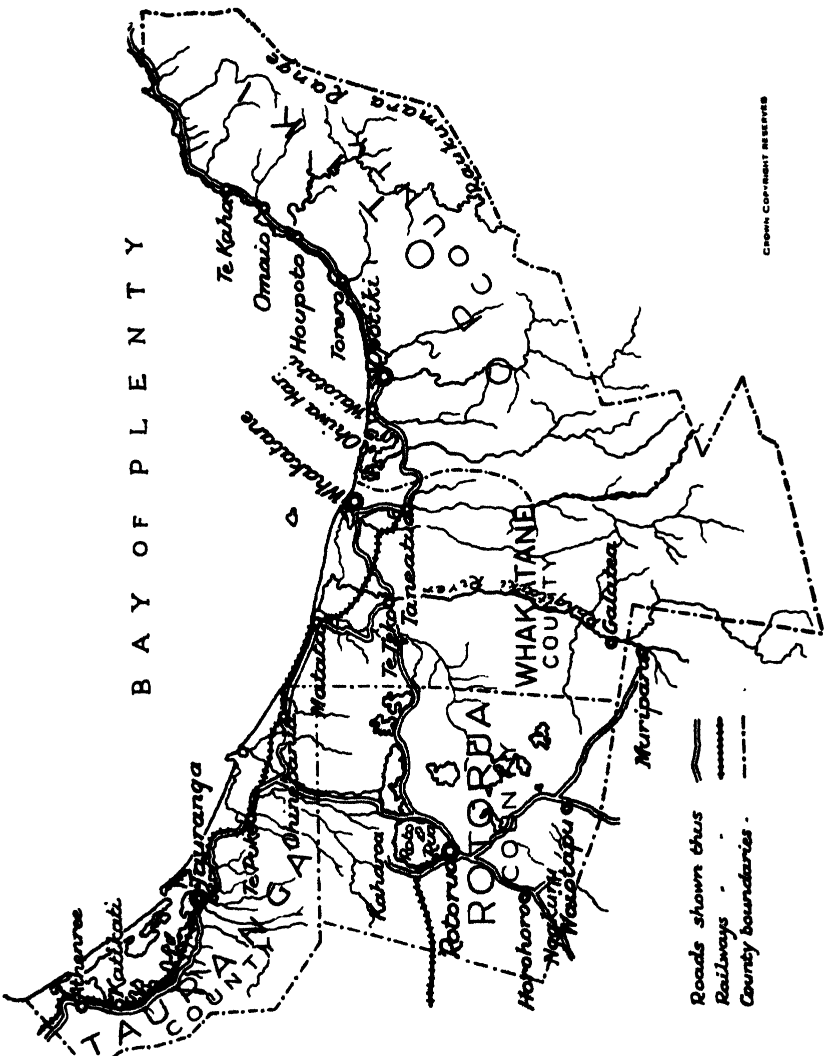

FIG. 7. SHOWING JOURNEYS IN TAURANGA, ROTORUA, WHAKATANE, AND OPOTIKI COUNTIES.

"provided for setting aside blocks of land as special settlements, and appointed immigration agents therefor, and authorized the Superintendent to contract with any person for the formation of special settlements, no settlement to contain less than ten families, whilst the area to be settled was not to be less than 1,000 acres." Under this authority settlements were formed at Te Puke, Katikati, Albertland,

Whangarei, and Kaipara, and brought many new settlers to the Province. The Auckland Land Board, on the 31st July, 1877, agreed to the setting-apart under section 56 of the Auckland Waste Lands Act of 1,874 of 10,000 acres in the Katikati district as a special settlement, and the Government was recommended to enter into a contract with George Vesey Stewart for the purpose. Mr. Stewart was to have the land surveyed at his own cost, price to be £1 per acre, of which 10s. per acre was to be paid in cash to the Agent-General in London, and the second 10s. per acre to be made by the introduction by Mr. Stewart rom the United Kingdom of one adult emigrant for every 75 acres of land—that is, 133 emigrants in all—the emigrants to be approved by the Agent-General and to be placed on the land on or before the 1st November, 1878. It was further contracted that " within eight months after the arrival of the emigrants he shall erect at least thirty-five weatherboard houses, one house for each block occupied, and to contain three rooms; that the emigrants shall be placed on the land and reside continuously thereon; that one-fifth of the total area shall be cultivated."(20)

One wonders just what was meant by " cultivated "—the profitable farming of this land was not possible until the development of transport, top-dressing, and dairy-farming. " We took a walk," writes Mrs. Hugh Stewart, of Athenree, " over wild, uncultivated, undulating land, feeling homesick and depressed . . . tea-tree (manuka) covered most of our land, was good for nothing but firewood, and after clearing, burning, ploughing, and cropping, came up again and again from seed. . . . Our cow, a recent purchase, was found next day staggering about, wheeling round and round in a most alarming fashion. Luckily a half-caste passing saw her and said, 'Your cow is tutu'd; give me a sharp knife,' and promptly bled her, cutting her ears, when she fell down exhausted, but did not die, as many of our cows did from time to time later on, when having eaten too greedily of a poisonous native plant 'tutu.' . . . The weather being very hot, Hugh got up at 5 a.m. to churn, I following suit when he called out 'Butter has come,' to pass it through the butter worker and make it up into pounds, wrapped in parchment paper stamped 'Athenree Separator.' . . . This year we had so good a crop of wheat that we sent six sacks of it to the Katikati miller, who in due time returned as many more of flour, pollard, and bran. . . . With an annual return of 8,000 to 10,000 eggs, I was able to sell some at prices varying from 6d. to 1s. 2d. per dozen. . . . I reared 150 to 200 chickens and ducks annually, with a ready sale at 1s. 6d. to 2s. each. . . . Sometimes we could get an order for 100 dozen lemons at 6d. . . . Onions at 1d. per pound, cucumbers 6d. per dozen, and tomatoes 1d. per pound were always saleable. . . . Hugh now invested in fifty-six ewes and lambs, which were the beginning of a little money-saving in mutton and money-making in wool. . . ."(21)

Until the advent of the dairy factory, farming was mainly subsistence farming, with farm butter, eggs, and vegetables as the marketable products. The grassing of the light soils on the fern-clad hills was done with low-fertility-demanding grasses, ratstail and *Poa pratensis*, for rye-grass, cocksfoot, and white-clover pastures could not be established without top-dressing. Old pastures have been gradually ploughed up and resown, and these low hills are now in quite fair pastures,

but ratstail persists in many fields, and at this time of year the dead growth on the ratstail plants gives the pastures a whitish appearance. Pasture-growth is at present short and dairy cows are being fed on hay, whilst on some farms the dry cows are grazing down maize-stalks.

Much of the inland hill country is not suitable for sheep without special treatment, the land being unhealthy, but recent work with limonite and salt-licks has shown that, provided management is otherwise good, sheep can be raised on sick country. Ragwort is becoming troublesome on much of this hill country, and sheep-grazing is the only economical way to control it. Continuing on towards Tauranga, citrus orchards become fairly numerous—here and there are lemon orchards in various stages of development, from young trees to trees in full bearing. The low, undulating coastal country continues right on to Matata, with at Te Puke some fairly extensive areas of drained coastal swamps, behind which rises a wide terrace, broken into easy undulations. It is a country of dairy-farms, and sheep are only seen on the coastal drained swamps. Pastures on the swamps are far more advanced in growth than the pastures on the undulating hills, chiefly on account of the greater proportion of perennial rye-grass in them. During the long period when false perennial rye-grass was the main rye-grass seed in the market, it was considered that this light undulating country "would not carry rye-grass." Rye-grass mixtures were certainly used, but the pastures were long-rotation rather than permanent, and a considerable amount of maize-growing and fodder-cropping was done. The introduction of certified perennial rye-grass has changed the whole aspect of farming this class of land, and the earliness of a dominant rye pasture on this light, undulating land was well exemplified in a demonstration plot examined at Te Puke. A square of rye and white sown in the middle of a pasture made a striking picture. The main pasture of the field consisted of cocksfoot, rye-grass, and white clover, with some ratstail here and there. The field had been hayed the previous summer, the cocksfoot-plants had become tufted, and recent frosts had whitened the cocksfoot-plants and growth was at a standstill; but the plot of perennial rye-grass and white clover was green and growing. Rye-grass, paspalum, and white clover make the ideal sward for Bay of Plenty conditions.

WHAKATANE COUNTY.

December 5th, 1934; Matata, Te Teko, Taneatua.—A fine, hot day, with hay and ensilage harvesting everywhere in full swing; lucerne crops have recovered from the first cut in November and are already 1 ft. high. Each year about 200,000 acres of pasture-land in the Auckland Province are harvested for hay and 60,000 acres for ensilage. Hay and ensilage crops then are of considerable importance and value. A great deal of hay harvested in the Auckland Province is cut late, is very fibrous, and is badly cured—either sun-bleached or harvested damp, turning out of the stack musty or mouldy. Ordinary dairying permanent pastures consist of rye-grass, cocksfoot, and white clover, with varying amounts of poorer grasses and clovers such as Yorkshire fog, sweet vernal, goose-grass, suckling clover. Hay of the highest feeding-value is obtained when the rye-grass is just coming into flower and the green material consists of rye-grass, white clover, and the leafy growth of cocksfoot. The greatest yield is usually obtained at a later

stage when the cocksfoot is flowering, but the rye-grass will then have become fibrous and the white clover dried. Early cutting gives a light yield of good-quality hay and a good aftermath, later cutting gives a higher yield of more fibrous hay and a very poor aftermath ; in fact, in a dry year a field cut for hay in January may not provide any real feed until March, and it may take a year or two of careful stocking and top-dressing to bring back a good sward. But early cutting for hay has the disadvantage that the weather in November and early December is often unsettled and haymaking is difficult. This is where ensilage-making comes in, for it is independent of the weather—the grass can be cut and ensiled at any time. Fields for both ensilage and hay should be closed early, and thus close subdivision is an advantage, for with close subdivision it is often possible to take a field from the grazing rotation by the middle of September, followed by other fields right through October, and allow of a really early start on ensilage-making, so that all cutting, both for hay and silage, can be finished in December. The rule of haymaking is to dry the hay as quickly as possible (by turning and shaking out) and as soon as it is dry protect it from bleaching in the sun and from wetting by the dew and rain. The introduction of mowers, swathe-turners, side-delivery rakes, sweeps, and stackers has hastened the work of haymaking and allows of the quick handling of hay during periods of good weather. But the introduction of machinery has not entirely solved the problem of haymaking—the weather cannot be controlled or forecasted, and no machine has yet been invented that will build cocks ; machinery costs money both to purchase and maintain, and an elaborate range of haymaking machinery is beyond the means of the average small farmer. Even with machinery, haymaking still necessitates the employment of casual labour, and reliable casual labour is difficult to obtain, for dairying does not provide fairly regular casual work for farm labourers as arable farming does (where seasonal work includes haymaking, cereal-harvesting, hedge-cutting, potato-digging, and root-thinning). The necessity for extra labour at hay and ensilage making has brought in the system of co-operative work amongst groups of farmers, but, as crops have then to be harvested in rotation, it usually results that haymaking is either rushed or the last crops are cut very late. The cause of most bad haymaking is lack of labour and machinery, and not lack of knowledge as to how good hay ought to be made.

Beyond Matata the country opens out into a large plain—the Rangitaiki Plains—stretching to Whakatane in the east and Te Teko in the south. It is a great fertile plain of drained alluvial soils and peat swamps. Development has proceeded rapidly, and the plains contain some of the finest dairying land in the province : the alluvial soils are light, formed of pumice from the Central Plateau, and are not troublesome to farm like the heavy alluvial soils of the Hauraki Plains. The land is generally held in comparatively small holdings, and the pastures are of excellent quality, with rye-grass, paspalum, and white clover as the dominant pasture-plants. Dairying is the main industry with the important side-lines of maize-growing and pork and bacon production. At Te Teko, at the southern end of the plains, the land is covered with a layer of Tarawera ash, a coarse gritty sand that holds moisture poorly ; this also covers much of the undulating to hilly land (in bracken fern and tutu) south of the plains in the valleys of the

Rangitaiki and Tarawera Rivers. Examined some pastures at Te Teko that were sown a few years ago on the light soils covered in Tarawera ash; for the first two or three years red clover was the dominant plant in the pastures, but it has now gone out and the pastures show a good deal of bare ground, with the white clover going off, due to the dry weather. On these light soils red clover is dominant in the pastures for the first three years, but these early years of high production are no measure of the ultimate carrying-capacity. Where the surface pumice soil is of good moisture-holding capacity, high-class permanent rye-grass and white-clover pastures can be maintained, but where the surface soil is coarse and holds moisture poorly white clover is not permanent and subterranean clover has yet to be tried to prove whether they can be satisfactorily grassed. Lucerne does well on these coarse sandy soils, and there are some excellent stands at Te Teko—established at the first ploughing of manuka land.

August 28th, 1935: Matata, Thornton, Whakatane.—I was very interested in the methods adopted by local farmers in the feeding and management of pigs. During the past two or three months I have visited a very large number of dairy-farms, and have been impressed with the need for a really practical method of housing and managing pigs on dairy-farms. I have seen hundreds of acres of small $\frac{1}{8}$ acre fields, only established a year or two ago, a hopeless sea of mud—fields that were established to give pigs *good clean pasture;* I have seen farms on which these small paddocks had become wet and muddy, and where farmers had again turned to sties, and where farrowing in sties had been unsatisfactory and the sows and suckers had again been turned out into the muddy yards on account of the young pigs scouring at three weeks of age; farms where both sties and small paddocks had been temporarily abandoned and all pigs given a free range of the whole farm. We have yet to evolve a satisfactory housing and grazing system to suit local conditions, and the keynote of the system must be the health of the pigs, and it must be a system that does not entail too much labour. Health is essential, and rapid gains in live-weight cannot be secured under unhealthy surroundings.

As a starting-point we may take it that pigs running on good, clean well-drained pastures are healthy, but once the grass turf on the fields deteriorates, and mud and water take the place of grass, pigs become unhealthy, chiefly through parasitic infection. Pigs can also be kept healthy in sties, but this entails a good deal of work. Sty-management is common in European countries, but even there this method is usually only satisfactory where the number of pigs kept is adequate (twenty-five to twenty-eight sows) to provide full-time employment for at least one man. In sties, if no run-out to grass is available, difficulties are experienced in the rearing of young piglets from about three weeks of age on account of scour. Where the young pigs are given a run-out daily on grass, even if for only a short period, scour does not appear; if a run-out is not available, the provision of a fresh turf or sod daily appears to overcome the difficulty. It is the work of keeping the sties and surroundings clean that makes them somewhat unsatisfactory for local dairying conditions, where the ordinary farm labour is fully employed in milking and farm work, and only five or six sows are kept. Drainage is often a difficulty, for a sty of ten baconers in the last stages of fattening will be getting about 6 gallons of skim-milk each per day—a total of 60 gallons of liquid food.

A few years ago there was a fairly general opinion that grass could be made quite an important item in the ration of fattening pigs, but recent work has shown that although grass is of value for mature pigs—*e.g.*, dry sows—it has little real feeding-value for young fattening pigs. The establishment of small ⅛ acre grazing fields aimed at giving pigs good fresh young grass, and it has broken down because the pig is a bad grazing animal, the turf on these small paddocks rapidly deteriorates, and also because pigs do not like short grass; they like fairly long grass—give pigs a free range of the farm and they will make for the fields that have been spelled and are ready for grazing by the dairy herd. The value of special pig pastures, such as lucerne, red clover, and white clover, where the pigs will get their food easily, is a matter now under investigation. But under our system of dairying, with pigs only a side-line, grazing-areas for pigs must figure largely in the final system adopted, for farmers have not the time or money for the elaborate system of indoor housing with occasional runs outside, and by running pigs out on good clean pastures their health is assured.

Pig-management on many dairy-farms on the Rangitaiki Plains has reached a high standard of efficiency, and the farmers are evolving a system worthy of imitation over large parts of the Auckland Province. Dry sows are run out on the large pastures of the farm, and this is general practice; at farrowing they are brought into small ⅛ acre paddocks; after weaning the weaners and sows are again run out in the larger paddocks of the farm, and then, when about 140 lb. to 150 lb., they are brought in and finished off for the last month or six weeks in sties. In the management of the small ⅛ acre fields it is recognized that if a good turf is to be kept on these fields other grazing stock must be used besides pigs, and during the maximum growing period of the grass—the late spring and summer—pigs are kept out of these fields and they are grazed with dry cows or yearlings, and, if necessary, the fields are mown. The question arises whether these ⅛ acre fields are really necessary, seeing that after a trial many farmers are now farrowing the sows on the general farm pastures, and a great deal of care is necessary to keep a good turf of grass on these small paddocks. It depends on circumstances, but there is a great advantage in keeping each sow and litter separate and handy for feeding and looking after. The whole success of pork and bacon production depends on raising weaners as near to 40 lb. at eight weeks as possible. During the rearing-period it is essential that the young pigs should grow steadily, and it is necessary to feed them from a separate trough from three weeks of age. Of course all this can be done in the larger fields, but only with increased time and work. However, large paddocks with good clean pastures and normally grazed by other stock are preferable to small paddocks with a bad turf and wet muddy patches. After weaning, the young pigs are run out on the ordinary grazing-pastures; they make quite as good gains as they do if shut in ⅛ acre fields and they should not be run so thickly as to spoil the grass for other stock At about 140 lb. to 150 lb. live-weight the pigs are brought in and sty-fed for the last month or six weeks. Care is taken in the construction of the sties that they are draught-proof and sunny: for a pen of eight to ten baconers the shelters are 9 ft. deep by 9 ft. wide and 4 ft. 6 in. to 6 ft. high, with a concrete yard of about the same size in front. The floors of the shelters are of wood, with a slight slope (about 4 in.) to the front. During the

period the pigs are being finished off in the sties they are given at least half a day a week run out in a good clean paddock to keep them in health.

I was also very interested in the methods adopted by local farmers in the feeding of maize to pigs. On the rich alluvial land maize crops will produce 80 bushels to the acre, and the rotation commonly adopted is to plough old grass, follow with swedes for winter feeding, and then maize for one, two, or possibly three years and then sow down to grass again. With this rotation the swedes and young grass provide adequate winter and early-spring feed for cows, and the maize pays for the cost of cropping and resowing to grass. It also allows of a good profit on pig-feeding, for local farmers estimate that, with maize for winter feeding, the profit from pork and bacon is in the vicinity of 3d. per pound of butterfat produced. The bulk of the maize is fed to autumn litters which are carried through the winter in a thriving condition and finished off for bacon in the spring and summer mainly on skim-milk. The maize is normally fed on the cob, and the cobs are soaked before feeding for about three days in the winter and thirty-six hours in the summer.

This Bay of Plenty rotation of swedes and maize is of particular interest, for the wider use of annual forage crops is often advocated as a means of increasing production on dairy-farms. Against the growing of annual crops for supplementary feeding is the fact that the tremendous increase in butterfat-production during recent years has been brought about by better grass-farming and not by the growing of annual supplementary feeding crops. The all-grass dairy-farm has greatly increased in favour: its success depends on good pastures, close subdivision, top-dressing, and a reserve of grass ensilage stored up for periods of scarcity. All supplementary feed is provided by hay and silage secured from permanent pastures. Pastures do not throw their feed evenly throughout the year, a good pasture produces about 75 per cent. of its annual production in the period October to January inclusive and 25 per cent. during the remainder of the year. An efficiently fed herd of good production requires 40 per cent. of the year's total supply of feed in the October to January period and 60 per cent. during the remainder of the year. The all-grass dairy-farm spreads the feed to the requirements of the herd by harvesting roughly 40 per cent. of the grassland for hay and silage. The system has been very successful; under it most Auckland dairying land is capable of producing 175 lb. to 200 lb. of butterfat per acre; some farms do more, even 300 lb. It is economical; there is no cash outlay for cultivation, seed, and fertilizer for annual crops and for resowing the land to grass. Its weaknesses lie in the labour necessary for hay and silage making and the tendency to lowered production in adverse seasons. Grass is often short in the early spring, and a really dry summer may seriously deplete the reserves of ensilage and lead to inadequate feeding the following winter. Also ensilage is not a complete substitute for young grass for milk-production. There are difficulties certainly in all-grass dairy-farming, but they can be overcome to some extent. The use of lucerne and paspalum increases the feed-supply over the summer months. Lucerne is warranted on all farms where the soil is suitable for its cultivation; the first cut can be used for

ensilage along with early-mown pastures, subsequent cuts can be used for soiling if pastures are short or turned into hay or silage if pasture-growth is good. Grass-growth in the early spring can often be increased by special top-dressing: shelter is also an important factor in helping grass-growth during the summer and early spring: it is strong winds that dry up pastures so much and cut back the growth.

Most annual forage cropping on dairy-farms is done as a stage in pasture renewal, for farms with poor pastures usually have a poor winter and early-spring grass-production—in short, the pastures lack rye-grass. Crops grown include swedes and mangels for winter feeding, green cereals for the early spring, soft turnips, millet, or maize for summer feeding. A common arrangement is to break up old grass in February or March, sow oats in April, feed off in the early spring (often the oats are omitted and swedes follow grass), replough, sow in swedes, and follow the swedes with soft turnips, millet, or maize for summer feeding and resow to grass in the autumn. The whole aim of the system is better pastures and better feeding—to get the land into good rye-grass and white-clover pastures and to carry more and better-fed stock. Many farms have greatly increased butterfat-production by using forage crops to improve the pastures, but once the farm is all in good grass, annual forage crops are dropped and reliance placed on grass. In short, it does not pay to break up good grassland to grow annual forage crops; but there is, I think, one exception, and the exception is where a cereal or a cash crop is grown in the rotation. This is what makes this maize and swede rotation in the Bay of Plenty so interesting. It is not necessary that this swede-maize rotation should be worked with permanent grass. It could be worked quite well with temporary pastures, for Italian rye and red-clover pastures would in many respects be more suitable. The pasture would be cheaper to sow, it would give more winter and early-spring feed, and in its second year the red clover would produce good summer feed. The use of temporary pastures might bring the swede crops somewhat close together in the rotation, but this could be overcome by substituting chou moellier for swedes in the later years of cropping. An analogous case to this maize and swede rotation is the potato cash crop taken on South Auckland dairy-farms. The two usual crops rotated with the potatoes are mangels and green oats, whilst the grass may be either temporary or permanent.

The rotation of forage crops with temporary grass, without a cereal or a cash crop, is often advocated but seldom practised. The idea is based on the fact that permanent pastures are most productive when rotationally grazed, and are not closed for hay and ensilage making. The idea is to rotate forage crops with temporary grass, save all hay and silage from temporary pastures, and keep the permanent grassland rotationally grazed throughout the year. The weakness of the system is the cost and labour required: if it is to be profitable it must increase the butterfat-production to the point where it pays for the cost of cultivation, seed, fertilizer, and labour. This it apparently does not do.

OPOTIKI COUNTY.

August 29th, 1935; Opotiki to Te Kaha.—A fine but windy day; the road follows the coast, passing the ends of the steep spurs leading

up to the Raukumara Range and crossing narrow shingle plains in the stream and river valleys. There are some fine flats at Opotiki used for dairying and maize-growing, but beyond Opotiki there is only a very limited area of ploughable land, and the country consists of ridge after ridge of steep greywacke hills in danthonia, scrub, and forest. Most of the easy coastal country is used for dairying by the Maori owners, and the pastures generally are poor, the swards consisting of ratstail, hair-grass, Indian doob, and trefoil, with rye-grass and white clover only where the land has been top-dressed. During recent years the Maori farmers have done a good deal of clearing up on the manuka-clad foothills, and have grassed after manuka burns ; quite good pastures of rye, cocksfoot, and white clover have been established, and, provided these are top-dressed, a good sward of grass should be maintained. The greywacke hills are mainly in danthonia and browntop—fairly clean on the sunny faces but showing a great deal of reversion to fern and manuka on the more shady slopes. At Te Kaha there is a Native settlement of Maori dairy-farmers. Here bullocks are used for farm work instead of horses—there are bullock carts, and bullock teams do the pasture-harrowing and other cultivation work. Some maize cropping is done, but after maize the land is usually allowed to tumble back to grass by itself, hence many of the pastures consist of ratstail, doob, hair-grass, and suckling clover. The surface-sown hill country is used for the extensive grazing of Romney sheep, and for the 1933–34 season there were 92,782 sheep shorn in the county.

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INTERNATIONAL STANDARDIZING OF HERD-BOOKS AND MILK-RECORDING.

EFFORTS have been made recently to reach more uniformity in methods of herd-book keeping and milk-recording in the different countries. As a matter of fact, these methods, as is clearly shown in a monograph published by the International Institute of Agriculture at Rome, differ greatly from one country to another and do not permit any comparison of data furnished by herd-book organizations and milk-recording societies. This is a considerable handicap to the international trade in pedigree animals and in international studies of genetics and dairy records, which are based on those data. Proposals to unify methods of milk-recording were made at the World Dairy Congress in Copenhagen, 1931, which distinguish three classes of milk-recording methods according to the degree of accuracy. The question of making herd-book methods more uniform has been discussed at the Agricultural Congresses in Prague and Budapest, and recently in a conference of experts held at the International Institute of Agriculture in February, 1935. The Conference has established some general principles of herd-book keeping as a basis for future uniformity. At present these proposals are being studied by the Governments of the different countries, and they will then be presented to a diplomatic conference for definitive adoption.

ST. JOHN'S WORT AND ALLIED SPECIES.

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THE genus *Hypericum* includes about 300 species, mainly of the temperate regions of the world. A number are ornamental shrubby or herbaceous plants, now grown the world over for their bright flowers or pleasing habit, some of the low-growing forms being prized for rockeries. The genus also includes several species that have become more or less objectionable weeds, notably St. John's wort. The majority are perennials with distinctly angled stems. The leaves are arranged in opposite pairs, and when held to the light are seen to be dotted with pellucid or sometimes black glands. Hypericum oil, of some slight medicinal value, is obtained from certain species, while many contain an acrid and slightly bitter juice yielding a yellowish dye. The flowers are occasionally solitary, but more often occur in groups at the summits of the branches, with a three-forked arrangement of their stalks. In most species the flowers are of various shades of yellow, but pinkish, rose, and purplish forms are known. The sepals and petals are in fives. sometimes gland-dotted, while there are numerous, usually showy, stamens, mostly grouped into five or three bundles. The ovary bears three or five styles, and the fruit is usually a dry capsule, but in some species becomes berry-like.

The following key and descriptions will serve to distinguish the six species commonly met with outside gardens in New Zealand.

1. Leaves 2 in. to 4 in. long, plant shrubby	2
Leaves at most 1 in. long, plant herbaceous	3
2. Flowers 3 in. across, styles five	*calycinum.*
Flowers 1 in. across, styles three	*androsaemum.*
3. Plant with erect stems	4
Plant with trailing stems	5
4. Plant robust, flowers numerous	*perforatum.*
Plant slender, flowers few	*gramineum.*
5. Leaves pointed at tips, margins with row of black dots	*humifusum.*
Leaves rounded at tips, margins without black dots	*japonicum.*

H. calycinum (Fig. 1), Rose of Sharon, Aaron's Beard: A low-growing, semi-shrubby plant with numerous procumbent stems, forming dense masses covering the soil. Leaves about oblong to oval, dark green above and bluish-green below, 2 in. to 4 in. long. Flowers usually solitary, bright yellow, with large sepals and petals. The long, showy stamens are in five clusters with reddish anthers. The fruit is a dry capsule.

The species is a native of the Caucasus, frequently grown in gardens, and has been suspected of poisoning stock. In North Island it is an occasional garden escape, but is hardly naturalized.

H. androsaemum (Fig. 2), Tutsan, Sweet Amber: An erect-growing shrubby plant with numerous two-edged stems. The leaves are usually broader than those of the Rose of Sharon and whiter below, about 2 in. to 4 in. long, and more or less heart-shaped at the bases. The flowers are usually in groups of three to nine, a lighter yellow than those of the Rose of Sharon, and about 1 in. across, with less showy anthers. The fruit is berry-like, about the size of a pea, and blackish violet.

This European species is occasionally grown in gardens, and has become thoroughly naturalized in New Zealand, being plentiful in certain "bush-burn" country in both islands. It has also been suspected of poisoning stock.

H. perforatum (Fig. 3), St. John's Wort: This species spreads by means of underground runners. The stems are erect and branching and carry masses of flowers. The height varies from 1 ft. to 3 ft. or occasionally even more. The leaves are about $\frac{3}{4}$ in. long, unstalked, narrow, oblong, with numerous pellucid dots. There are several varieties, a narrow-leaved form, rare in New Zealand, appearing to be the commonest form in Australia. The flowers are borne in flat-topped clusters at the summit of the stems, the petals are of a rather deep yellow with black dots on the margins. The long yellow stamens are in three

FIG. 1. FLOWERING BRANCH OF *H. calycinum*, ROSE OF SHARON.

FIG. 2. FLOWERING AND FRUITING BRANCHES OF *H. androsaemum*, TUTSAN.

clusters, and there are three styles. The fruit is a three-celled capsule, with numerous seeds, dark brown, with rows of minute depressions.

This European species is now widespread in New Zealand, and is especially prevalent in certain hill-country areas in South Island. The underground runners (Fig. 4) make it difficult of eradication when once it is established, and the plant tends to dominate large areas. On cultivated land control is comparatively easy, and is discussed by Hughes (this *Journal*, May, 1915), who points out its heavy-seeding proclivities. On small patches salt applied after the plants have been cut close to the ground has proved effective in hot dry weather. A considerable measure of success has been obtained with sodium chlorate, using a solution of about 5 per cent. The possibility of control by insect enemies is under investigation.

Apart from its general objectionable features as a pasture weed, St. John's wort is distinctly under suspicion as a stock poison. Recently attention has been focused on it in connection with facial dermatitis

FIG. 3. FLOWERING BRANCH OF *H. perforatum*, ST. JOHN'S WORT.

in sheep. Seddon and White (Vet. Research Rep., 1927–28, Dept. of Agric., N.S.W., p. 106) have shown that St. John's wort when eaten by sheep produces photo-sensitization, followed by the characteristic

symptoms of facial dermatitis (see also Hopkirk in this *Journal*, February, 1936). The plant was found to be common in one of the areas in South Island, where outbreaks of facial dermatitis have occurred.

FIG. 4. *H. gramineum* (ABOVE), AND ST. JOHN'S WORT (BELOW), SHOWING THE UNDERGROUND RUNNERS.

H. gramineum (Fig. 4): This species rather resembles stunted *H. perforatum* but lacks the strong underground runners of that species. The stems are slender, seldom more than 12 in. long, the leaves are

FIG. 5. PLANT OF TRAILING ST. JOHN'S WORT, *H. humifusum.*

about ½ in. long, about oblong in shape, with a somewhat heart-shaped and stem-clasping base, with many pellucid dots. The flowers are solitary, or, in well-grown specimens, in three-forked clusters. The petals are of a golden yellow, and smaller than those of St. John's wort.

This small species is a native of Australia and New Zealand. In this country it occurs in both Islands, being most plentiful in the lowland tussock grasslands of South Island. It is under suspicion as a photo-sensitizer.

FIG. 6. JAPANESE ST. JOHN'S WORT, *H. japonicum.*

H. humifusum (Fig. 5), Trailing St. John's Wort: This is a very low-growing plant with numerous prostrate angled stems forming small close mats usually appressed to the ground. The leaves are oval,

bluntly pointed, about ¼ in. to ⅓ in. long, bluish-green with a distinct marginal row of black dots. The flowers are small, towards the tips of the branchlets, the sepals more pointed than in the following species.

This native of Europe is now naturalized in both Islands, and is plentiful in certain localities in North Island, especially on clay soils. Its powers as a photo-sensitizer do not appear to have been investigated.

H. japonicum (Fig. 6), Japanese St. John's Wort: Rather similar to trailing St. John's wort, but more delicate, with much less wiry stems and leaves with rounded tips, the margins without black dots. The leaves seldom more than ¼ in. long, often of a brown purple tinge; flowers usually solitary, sepals less pointed. A native of New Zealand, Australia, and eastern Asia. In New Zealand it is a frequent plant of moist ground, especially on the margins of swamps. In parts of South Island tussock grassland it forms a distinct girdle about the "lagoons" and ponds, and is frequent in certain of the areas subject to facial dermatitis. Feeding-tests are being carried out with it. (See article by Hopkirk, already cited.)

REFRIGERATION IN THE DAIRY INDUSTRY IN NEW ZEALAND.*

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BUTTERMAKING.

THE necessity for control of temperature in buttermaking has been recognized ever since the days when its manufacture was confined to the individual farm, and in the temperate zone those farms with a cold-water supply were, other things being equal, generally found to be the ones on which good-quality butter was made.

In the colder dairying countries of the Northern Hemisphere natural ice was used for cooling the cream, and the "Swartz" system of deep-setting of milk to allow the cream to rise is recorded in European countries in 1867.

In the "Swartz" method the milk was held in deep oval-shaped cans, which were placed in a large container with broken ice packed round them. After standing for twenty-four hours or longer, the skim-milk was run off through a tap at the bottom, and the cream was sent to a central butter-factory from farms and skimming-stations operated on this principle. Although the continuous-flow centrifugal cream separator was invented in 1878, the "Swartz" system was still in use in 1904 (Swedish Handbook, 1904), so that the fat losses in the skim-milk could not have been excessive.

As no natural ice was available in New Zealand, the earliest butter factories (1882) were equipped with a deep-setting method in which water took the place of the ice used in the "Swartz" system, but it can be understood easily that the fat losses would be excessive owing to the rapid coagulation of the milk in hot weather. The centrifugal separator was not then available, and there was no mechanical refrigerator which could be placed in the hands of the ordinary factory employee, and this,

* Paper read before the New Zealand Association of Refrigeration, Inc., February, 1936.

combined with the lack of refrigerated cargo space on overseas ships, was probably the reason why most of the early factories were equipped for cheesemaking.

THE FIRST SEPARATORS AND REFRIGERATORS.

The separator came into common use in butter-factories about 1890, but the cooling still depended on the water available, salt brine or ice procured from near-by freezing-works being used for cooling the water for butter-washing. Although some factories were equipped with refrigerators at that time, and these were used in a few instances for cooling water for washing the butter after it was churned, in most cases they were used only for cooling the rooms in which it was held overnight. Owing to the soft character of the butter churned at these high temperatures, the practice was to partially work and salt it when removed from the churn and to complete the working the following day. Churns at this period were simply an oblong box, and the workers in use were a circular revolving table with fluted rollers, the butter being turned by hand during the working process.

Butter made under these conditions was necessarily of poor quality, due to the high acidity of the cream at churning and the high curd-content of the butter, both of which materially affected the keeping-quality while the body and texture were poor and the fat-content of the buttermilk was at times over 5 per cent. This class of butter, while fairly satisfactory for the local market, was quite unsuitable for an export trade.

During 1896 a visit was paid to Australia by Mr. J. B. MacEwan, who was at that time in charge of the Dairy Division of the Department of Agriculture in New Zealand. Mr. MacEwan reported that "The success of the (Victorian) butter industry as compared with New Zealand is largely due to their adoption of adequate refrigeration in the factories, the heat of summer practically leaving no option, and therefore acting as an indirect benefit."

This report was no doubt the reason for the first recorded attempt to control the temperature throughout the buttermaking process, an attempt which was made by the Moa Farmers' Co-operative Dairy Co., Ltd., of Inglewood, which in 1896 despatched one of the directors to Australia in search of a suitable cooling plant.

The plant chosen by the Moa company was a two-stage Humble and Nicholson compressor of one-ton ice-making capacity, which had attached to it a cream-vat with direct expansion coils in the water-jacket, a similar coil for cooling water for butter-washing, a brine wall with coil for cooling the room in which the butter was held overnight, an ice-tank for making ice which was sent to the skimming-stations to cool the cream, which was then transported to the main factory in an insulated van with ice-pan.

From this date the ammonia compressor was practically the only type installed in butter-factories, the Humble, Linde, and Hercules being the three makes chiefly favoured. The installation and the equipment supplied with the machines was not suited to the requirements of the dairy industry, dealing as it did with comparatively high temperatures and short periods of time on different circuits, and the first few years after mechanical refrigeration was available were practically devoted to a determination of the best methods of utilizing the cooling plants installed.

CREAM-RIPENING.

Buttermaking was at that time carried out chiefly on the cream-ripening method, under which a comparatively high acidity was developed in the raw cream by the use of a pure culture starter. This required that the cream should be reduced from the separating temperature of about 100° F. to the ripening temperature of about 65° F., water coolers being used for this purpose. The starter was then added, and as the acidity developed the cream became more viscous. After reaching the desired acidity it was cooled to a churning temperature round 55° F. by means of coils in the water-jacket of the vats, which were rectangular in shape, or by the use of attemperators submerged in the cream. These were vertical coils through which chilled brine was pumped while they moved back and forth across the vats or horizontal coils which rose and fell. This was a long and expensive system, and in at least one of the earliest factories the ripening process was never adopted, probably because of the expense of cooling.

HOME SEPARATION.

The adoption of the home-separation system in the early 1900's made it necessary to add a neutralizer to the sour cream received in order to reduce the acidity and the viscosity, as it was found to be impossible to pasteurize the cream and cool it unless this was done, and an unpasteurized cream butter of such high acidity would not keep. This led to the general adoption of pasteurization, and the use of a starter in buttermaking was gradually dropped, and if used at all at the present time it is simply added to the cream without a ripening period being allowed.

CREAM PASTEURIZATION.

As a result there developed a system of buttermaking under which the cream was pasteurized and immediately cooled to churning temperature while passing over the coolers, and, in order to provide for the rapid reduction from a temperature exceeding 200° F. to about 38° to 40° F., chilled water or brine circulating through the last of a number of coolers was brought into use. It is doubtful whether the cost of cooling was increased as the result of pasteurization at these high temperatures because of the greater efficiency obtained by the adoption of these methods, and to the more fluid nature of the cream dealt with.

DIRECT EXPANSION CREAM COOLERS.

As factory outputs increased the capacity of the compressors in use was found to be insufficient, and in 1922 the first direct expansion ammonia cooler came into use. By its use greater efficiency was secured from existing refrigerating plants, but it has not proved an unmixed blessing, as it has been found to be one of the causes of lack of spreadability in New Zealand butter unless care is exercised in its use. Experiments have shown that where the cream is allowed to cool slowly—the practice followed when a ripening period was allowed—the butter made is more plastic even after being held in cold storage. Where "shock" cooling over direct expansion coolers is practised, especially where the cream is at a comparatively high temperature when delivered on to a cooler showing a hard frost, the butter is liable to be of a hard brittle nature and is difficult to spread. This is due, it is believed, to

the crystallization of the fat. It is suggested that to avoid this defect two direct expansion coolers should be used, the first to be regulated to give comparatively slow cooling, and the second to reduce the cream to the desired temperature for holding overnight. Although the temperature of the cream at churning may be the same by both methods of cooling the resulting butter has very different characteristics.

Firmness combined with plasticity in New Zealand butter commends it to users in hot weather, but lack of spreadability in cold weather is a frequent cause of complaint, as it gives a butter which is not economical in use, and this causes difficulties in institutions where buttered bread is served in large quantities. This defect was probably accentuated at this period by the practice followed in some factories of cooling the cream to a temperature as low as 34° F. and holding it overnight in vats which, in some instances, were not provided with water-jackets and coils, and in others without insulation also. The rise in temperature overnight due to summer conditions and to the latent heat in the cream was frequently as much as 12° F.

CREAM-VATS.

With the increase in the outputs of factories rectangular vats of 200 to 1,000 gallon capacity have been replaced by all metal circular vats of 1,000 to 3,000 gallons capacity, fitted with "staybrite" linings, water-jackets with ammonia coils and cork insulation, and the practice most generally followed is to reduce the cream to the desired churning temperature and cool the jacket of the vat just sufficient to maintain that temperature overnight.

These vats have brought with them the problem of the efficient stirring or mixing of this large body of cream in order to avoid uneven temperatures between that portion in contact with the cold sides of the vat and the portion in the centre with consequent uneven cooling of the fat which may cause increased fat losses in the buttermilk.

CHURNING-TIME.

The change from the older method of ripening the cream for churning, which is still practised in most dairying countries, and which produced cream of a high acid viscous character, to pasteurized unripened cream of a more fluid character, coupled with the adoption of the combined churn and worker, had a very far-reaching influence on butter-factory practice and on the quality and character of New Zealand butter.

Under the former system churning temperatures had to be maintained at a comparatively high point in order to avoid an excessive churning-time because of the viscous nature of the cream. As a result, the loss of fat in the buttermilk was comparatively high, there was a difficulty in freeing the butter from the buttermilk owing to its soft character when churned, and, in spite of at least two washings with water at a temperature of several degrees below the churning temperature of the cream, the finished butter contained a comparatively high amount of curd, which has a direct bearing on its keeping-quality.

After the adoption of pasteurization it was found that, owing to the fluid nature of the unripened cream and the consequent increase in the agitation during the churning process, temperatures could be reduced by 10° or more below the former figure without unduly prolonging the

churning period. As a result, the fat-content of the buttermilk was reduced, only one washing was required, the curd-content of the butter was also reduced, and the keeping-quality correspondingly increased.

THE COMBINED CHURN AND BUTTER WORKER.

The early churns of the combined type were procured from countries where churning temperatures were comparatively high, and the butter when churned was consequently of a soft spongy nature and retained a large percentage of water. A slow churning speed of about thirteen revolutions per minute was necessary in order to finish with the butter in a granular form, and in order to avoid reaching the maximum legal water-content of 16 per cent. before the working process was complete it was necessary for the barrel to travel at a slow speed to allow the water to drain out while carrying the butter up on to the workers. The working speed was about one and a half revolutions per minute, which would require up to forty-five minutes to work the butter if the cream were reduced to the low temperature in use to-day.

By reducing the churning temperatures of the more fluid pasteurized cream it was possible to increase the churning speed to twenty revolutions per minute, and the butter when churned is now of a hard, dry, granular character, and free from buttermilk. The working speed was increased to about three revolutions per minute, thus reducing the time for working to about ten minutes, and thereby increasing the amount of work which can be done by each churn daily. To meet this change in temperatures it has been necessary to provide much heavier construction and driving-gears in churns imported to New Zealand, and as time went on the type now in use which churns from fifty to sixty-five 56 lb. boxes of butter instead of fifteen to twenty boxes as formerly has been evolved. These churns are all made in New Zealand.

VARIATIONS IN CHARACTER OF BUTTERFAT.

Under these conditions it is possible to alter the churning temperatures to suit the varying character of the butterfat produced in different districts and at different seasons of the year. Thus, it may be necessary to reduce the temperature of the cream to 40° F. in one district and to only 50° F. in another, while there may be several degrees difference between spring churning temperatures when the fat globule is large and soft and autumn temperatures when it is small and hard, even in the same districts.

The aim of the buttermaker is, then, to regulate the churning temperature of his cream so that the butter is churned in about forty-five minutes and that the moisture-content of the finished butter will reach 15·7 to 15·8 per cent., when his judgment tells him that the working process is completed.

INFLUENCE OF CHURNING TEMPERATURES.

Should the temperature be too high the churning-time will be reduced, the butter will be soft, and the water-content will reach the maximum before the salt and moisture are evenly distributed, and the butter will probably be streaky and leaky—that is, showing free moisture.

Should the temperature be too low, the butter will be hard and the working process will have to be carried on until it has become soft enough to " take up " the moisture, and the finished butter will probably have a greasy texture.

MOISTURE-CONTROL.

Control of churning temperatures in conjunction with the combined churn and worker has given a control of the moisture-content of New Zealand butter which is purely mechanical, and has raised it from about 10 per cent. in the early days of the industry to an average of 15·535 per cent. for the whole of the Dominion for the year 1934–35, or approximately 10,000 tons of butter on an output of 165,000 tons.

SALT-CONTROL.

Temperature-control has also made it possible to standardize the alt-content of New Zealand butter more accurately at whatever figure is desired. Butter churned at a high temperature retains a larger quantity of water in the soft spongy mass after the wash water has been run off than does the butter churned at a low temperature. The quantity of water in the first instance is usually in excess of the amount required to reach the legal limit in the finished butter, and consequently the excess must be run off at some stage of the working process, with the result that some of the salt is carried off with it. Where the churning temperature varies this may result in a difference of ½ per cent. in the finished butter between two churnings, although the same percentage was added to each. This has three disadvantages—loss of weight of the finished butter, waste of salt, and irregularity of salting, which is undesirable from the distributors' point of view.

MAKE AND KEEPING-QUALITY.

Two points of the greatest importance were recognized in the very early stages of the industry by New Zealand buttermakers. The first was the importance which temperature-control played in making it possible to obtain an even distribution of the other ingredients in the fat, and thus to produce butter which was well made, or, in other words, firm in body, smooth in texture, and of uniform composition and character. It is generally accepted that New Zealand conditions admit of the production of butterfat which is of such a character that the body and texture of the butter is the envy of the dairying world, and full advantage has been taken of that fact by makers.

The second was the importance which these characteristics played in keeping-quality, a point which was not recognized by many dairying countries having a domestic or near-by export market, but which is of the greatest importance to New Zealand, which depends on seasonal production and on overseas markets that entail long periods of storage to give "spread" delivery.

In actual fact, mechanical refrigeration was used in the dairy industry in the Southern Hemisphere at an earlier stage than in those countries where natural ice was available, and was applied much more intensively as indicated by articles dealing with "Leaky Butter," "The Keeping-quality of Well-worked Butter," and others of a like nature which appear in dairying journals of other countries.

CHEESEMAKING.

Refrigeration does not play such a prominent part in cheesemaking as it does in buttermaking, and, as already stated, it was probably this fact which was the cause of most of the early factories taking up cheesemaking.

The availability of a supply of cold water had, however, an equal influence on the quality of the cheese made on the farms, as the rate of development of the acidity during making depended largely on the condition of the night's milk when the rennet was added next morning. It was for this reason that milk was received twice daily, and in some instances morning's milk only was received by some of the early factories.

While cool conditions were provided on some farms by using a cellar for a cheese-curing room, similar conditions were obtained in other instances by the use of caves for this purpose.

The earliest factories built in New Zealand, however, had an upstairs curing-room in many instances, some being immediately above the making-room, and this practice is still followed on the farms and in factories in Britain.

COLD-CURING.

In 1903 experiments were carried out on the cold-curing of cheese in Canada, and the conclusions reached were that the quality of the cheese was much improved, while loss from shrinkage was reduced.

In 1907 the Department of Agriculture collaborated with the Dalefield Co-operative Dairy Co., which installed a refrigerator in the curing-room at their factory, and, while the results were satisfactory, the practice was not continued, due probably to the fact that the rooms were not properly insulated.

INSULATION AND COOLING OF CURING-ROOMS.

Provision for cooling has been made from time to time in a number of factories, but has not been regularly used, although most of the curing-rooms built in recent years in the North Island and some in the South Island have been insulated. In these, advantage is taken of the cold night air by opening the louvred windows which are placed between the rows of shelves on opposite sides of the room, which is usually built so that no other part of the building obstructs the passage of air on either side. During the day these windows are closed

The hot summer of 1934–35 impressed cheese-manufacturing companies with the necessity for more attention being given to the control of the temperature of curing-rooms, many of which exceeded 80° F. during the day, which caused the fat in the cheese to melt, and complaints of gritty, sandy body were very numerous in reports received from Britain. As a result a large number of rooms have been insulated with cork and other materials, and a lesser number have been equipped with refrigerators, most of them being automatically controlled. Provision of this type will probably be recognized in the near future as necessary in all curing-rooms.

STORAGE OF MILK SAMPLES.

Another use for mechanical refrigeration in the cheese industry is the provision of cooling-units for the storage of milk-samples in those factories which have taken up the question of payment for cheese milk on yield. It has been found that where these units are used the samples of milk can be kept for the required ten-day period in satisfactory condition for testing for casein by the Walker method, and from this result and the fat test the yield of cheese can be calculated. Such cooling-units have been installed in a number of factories during the current season.

The methods of application of refrigeration during storage at the port of shipment and on overseas ships have been greatly improved during recent years, but the varying condition of cheese cargoes landing in Britain indicates that there is still room for improvement.

From the foregoing it will be seen that even apart from the dependence of the New Zealand dairy industry on refrigeration for the delivery of its products on overseas markets, it plays an essential part on the manufacturing process in buttermaking and a lesser one in cheesemaking; but there is another possible sphere of usefulness which yet remains to be exploited—namely, the provision of a cheap and efficient means of cooling milk and cream on the farm, whether it is to be used for manufacture or for city supply.

SPECIAL CROPS FOR USE IN PIG-KEEPING.*

FARM EXPERIENCE IN MANAWATU DISTRICT.

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SURVEY OF GENERAL POSITION.

IN assessing the potential value of special forage crops for general use in pig-meat production considerable assistance may be obtained from a knowledge of the different current practices and of the results of these practices.

In the statements which follow, the farmers considered are primarily those engaged in pig-meat production as a side-line; those engaged principally in the breeding of stud animals and those supplementing the normal supplies of feed by supplies of buttermilk or of whey obtained from external sources are not taken into consideration. Of dairy-farmers considered, there are a relatively small number who are obtaining satisfactory financial returns, and a large number whose returns in comparison with the satisfactory ones just mentioned are distinctly disappointing. A measure of the differences in the results of those whose financial returns are satisfactory and of those whose returns are disappointing is provided by comparing the data relative to the farmers embraced in the 1935 report of the Manawatu-Oroua Pig Development and Recording Club with corresponding data relative to typical farmers of the same district as indicated in the survey made by the Department of Agriculture and recorded in the report of the Dairy Industry Commission. In the 462 litters covered by the report of the Pig Development and Recording Club, the average number of pigs weaned was seven, and incidental evidence indicates that in the majority of cases two litters a year were obtained. Hence it would seem that at a modest estimate about twelve pigs were reared from each sow in the year. Against this, on the seventy-three farms covered by the survey recorded in the report of the Dairy Industry Commission only 6·4 pigs were obtained from each sow in the year. That the operations on the seventy-three typical Manawatu farms compare favourably with those of Dominion farms generally is clear from the following facts: in the Dominion as a whole last year 4·2 pigs were slaughtered for every ten dairy cows; on the seventy-three Manawatu farms 5·8 pigs for every ten cows.

* Portion of an address to the Manawatu-Oroua Pig Development and Recording Club.

It is most significant that those who are securing quite satisfactory returns from pig-meat production fall into three distinct groups, whose returns in a general way vary according to the extent to which they employ farm-grown feed other than dairy by-products.

Group 1 consists of those who breed and rear to slaughter-stage practically all the pigs which are sold off their farms. Their purchases of pigs are confined almost wholly to breeding-animals and are designed to maintain or improve the standard of their stock. Their purchases of feed are also very limited. One Manawatu farmer of this group produced 66 lb. of pig-meat per 100 lb. of butterfat, and his outlay on purchased feed was less than 5s. per pig sold.

Farmers of group 2 correspond with those of group 1 in their operations, which, however, are supplemented by an important additional feature. This is the sale of weaners, and, normally, the greater the extent of this the greater is the consumption of farm-grown feed other than dairy by-products. Further, the greater the extent of the weaner sales, the more satisfactory are the returns.

Group 3 goes a step further than group 2 in that it does all that group 2 does and in addition buys in stores when they are cheap. These stores during periods of scant supply of by-products are fed on farm-grown feeds. The returns of farmers belonging to group 3 are more satisfactory still than those of group 2, and the proportion of farm-grown feed other than dairy by-products used is the highest of all. In the 1933–34 season one farmer of this group from pig-keeping grossed over £6 and netted £4 4s. per cow milked.

A fact of basic importance is that farms of group 2 and group 3 are not self-contained units. Both exploit the improvidence of their fellow-farmers: group 1 by selling pigs (mostly weaners) when they are unduly dear, and group 2 by selling pigs (weaners usually) when they are unduly dear, and again by buying pigs (stores and possibly weaners) when they are unduly cheap. The point of practical importance is that both groups are enabled to exploit the improvidence of their fellow-farmers mainly by the use of feed other than dairy by-products grown on the farms. The question of practical moment is, What feeds have been used for this purpose?

VALUE OF PASTURES DEMONSTRATED.

Field experience shows that in this district grass may be employed with marked success when judged on the basis of net returns. This statement does not apply necessarily to the feeding of grass to pigs being prepared for slaughter. About this our knowledge is incomplete, but available evidence points to the possibility that in respect directly and exclusively to economy of nutriment not a great deal, if anything, is to be gained by grazing such pigs.

But the value of grazing for breeding-animals and for young pigs has been so well demonstrated in this district as to be beyond doubt. Extensive field practice has shown conclusively that breeding-animals can maintain themselves in good condition on good grass alone. By using grass for the maintenance of breeding-animals a greater amount of the dairy by-products becomes available for the production of pig-meat for sale. It is generally agreed that pig-meat production to be economical in respect to the amount of feed consumed calls for the use of concentrates, and so it becomes of practical moment to bear in mind that

skim-milk is a concentrate—a diluted one certainly—but nevertheless, in essential features a concentrate, and to bear in mind, further, that concentrates, being of such special value, should be replaced by inferior feeds when this is possible. The practical application of all this is that pigs should be maintained as much as possible on grass, &c., and that as large a proportion as possible of the dairy by-products should be used for rapid meat-production. Successful results from the feeding of grass in the Manawatu are being obtained from adopting to a considerable extent but, as a rule not wholly, the extensive system of grazing as distinct from the intensive system which involves the use of small paddocks exclusively in the manner which has been advocated at times.

Two features of the use of grass by pigs calls specially for attention: (1) The best results are dependent upon the grass being of really good quality—young and leafy; (2) the supply of grass must be adequate. In respect to the provision of grass, the requirements of the pig probably are, at times, underestimated. They may be gauged from the following data taken from Marshall and Halnan's "Physiology of Farm Animals": The joint maintenance requirement per day of two pigs of 250 lb live-weight is approximately 5 lb. of starch-equivalent—some of the sows which were weighed at Massey College and which were not considered abnormally large were of 500 lb. live-weight; the maintenance requirement per day of a 1,000 lb. Ayrshire cow is 5 lb. of starch-equivalent, and that of an 800 lb. Jersey is 4·3 lb. starch-equivalent These data enable the pigs' grazing requirements to be assessed relatively and at the same time indicate the substantial saving of dairy by-products for rapid flesh-production that is effected by maintaining breeding-animals as much as possible on grass.

Causes of Unsatisfactory Results in Grazing.

Unsatisfactory results from grass are not infrequent, and they are due almost invariably to lack of quality or of quantity or of both in the grass. Especially does the lack of quantity operate in the winter and early spring. A marked weakness of our farming is inadequate supplies of grass for dairy cattle in the winter and early spring. To add pigs to the consumers of grass during this period is simply intensifying a common weakness.

The Role of Special Forage Crops.

The remedy is the growing of special crops, including such ones as mangels, carrots, swedes, chou moellier, pumpkins, peas, barley and maize for grain, and lucerne, cereals and temporary pastures for green feed.

In this connection a general question of basic importance is the cost of growing such crops. It is not merely futile but misleading to consider this matter of costs as involving an application of simple book-keeping to crop-production. For instance, to set down a string of items such as ploughing, disking, drilling, harrowing, weeding, rent, &c., as the cost of producing a crop of mangels may be an interesting academic venture, but unless there are actual payments relative to such items, then such a proceeding is of negative practical value, if taken seriously—of negative value because it gives as the cost of the crop an amount which really is not the cost.

To simplify consideration of this matter, mangels correctly may be taken as a typical crop. In practice the cost of a crop of mangels under the farming-conditions being considered consists of two main parts: (1) Direct payments covering material and labour used in raising the crop; (2) the net value of what alternatively would be produced from the land with the labour and equipment customarily provided on the farm.

This being so, the cost of a crop of mangels varies greatly from farm to farm. For instance, on some farms the growing of mangels may call for considerable direct payments for labour. On the other hand, on many farms, indeed on most farms, the current provision of labour and equipment allows of a crop of mangels being grown. This position is true of the other crops mentioned. Hence, in actual practice, one farmer correctly may be advised not to grow special crops for pigs while neighbouring farmers may be well advised to grow such crops because of the difference in costs. The latter farmers greatly predominate in this district.

In brief, farmers individually must decide for themselves the matter of special-crop production. And, in doing this, they must avoid fictitious items of cost originating in academic considerations. A most important fictitious item often is that covering the cost of replacing a pasture broken up to provide an area for a special crop.

On most farms there are pastures which should be broken up and resown in the interests of their future production as pastures and apart altogether from any considerations relative to special crop-production. If, in doing this, a special crop which pays or more than pays for itself can be grown as an intermediate step so much the better, but to charge against this crop the cost of resowing the pasture is weighing the case unjustifiably against special crops.

FEEDING-VALUE OF MANGELS AND SIMILAR CROPS.

As at times doubt is expressed about the suitability of mangels and similar crops for feeding to pigs, it is as well to consider what has been established. Probably the greatest amount of work and certainly the pioneering work in this matter has been carried out in Denmark largely under the direction of N. J. Fjord. Harold Faber sums up this work in the following statement: "The feeding trials conducted by N. J. Fjord . . . had, then, in the course of a few years given definite answers to the questions as to the feeding-value of roots. They had shown that roots had a considerable value; that roots could replace corn and oil-cake in the food of both cows and pigs without changing their growth or the production of milk . . . On weighing in some of the experiments the amount of water drunk by the cows, it was found that the cows fed on roots drank less water, and that this decrease was about equivalent to the amount of water contained in the roots they consumed. It has, further, been clearly established by these experiments that different varieties of roots have different feeding-values, according to their varying amounts of dry matter or total solids, that the different strains within the same variety have different contents of dry matter, and therefore different feeding-values. . . . As a general conclusion it has been proved that 1 lb. of dry matter in roots has the same feeding-value as 1 lb. of corn, or is equivalent to 'one unit of food' In the 30th report it was found that pound for pound the dry matter

in mangels and carrots had the same feeding-value for pigs; in the 42nd report it was found that pound for pound the dry matter in Yellow Tankard and Bullock turnips and in Bangholm swedes had the same feeding-value for pigs as the dry matter in Eckendorf mangels; in the 53rd report it was found that 1 lb. of dry matter in mangels had the same feeding-value for milch cows as 1 lb. of corn when fed in the usual mixed fodder."

The Cambridge School of Agriculture gives the following figures relative to the average dry-matter content: Carrots, 13 per cent.; mangels, 13·2 per cent.; swedes, 11·5 per cent.; turnips, 8·5 per cent.; chou moellier, 14·8 per cent. While these figures may differ to some extent from New Zealand ones, they enable interesting comparisons to be made. For instance, it may be deduced from them that a 60 ton crop of mangels has the same feeding-value as the grain from 7 acres of a crop of barley yielding 50 bushels to the acre, or of 4 acres of a crop of maize yielding approximately 90 bushels to the acre. From such a comparison one can well understand the great role played by root crops in the farm economy of the Danes, who at an early stage established that roots in essential respects really are diluted concentrates.

The reference to the water-content of roots in the above quotation from Faber is of some practical moment because of the occasional tendency to discount the value of certain feeds to an unjustified extent on the score of their bulkiness. Actual farm experience shows that when high digestibility is linked with bulkiness, then mere bulkiness does not impair the feeding-value to the extent that some seem to expect. An instance of this is provided in the feeding of skim-milk to pigs; a more striking instance is the feeding of whey, the dry-matter content of which is substantially lower than that of, say, mangels or swedes. A further instance is the feeding of soft turnips to dairy cows: the splendid results obtained in the late summer from the turnip are due primarily to its equivalence to a concentrate in respect to digestibility, its content of dry matter being relatively poor.

Crops which may be Grown.

In respect of such important crops as mangels, chou moellier, swedes, carrots, and cereals, or temporary pastures, provision for the requirements of pigs often may be made readily by merely adding to the areas which are grown to meet the requirements of other classes of stock. However, if it is not considered necessary to grow carrots and chou moellier for the latter it may nevertheless be advisable to grow them on special areas for pigs for use prior to the mangels becoming mature enough for use.

In practice, lucerne has been found of special value for pigs as a summer grazing crop, and for this particular purpose it would often be well to have a special area separate from the area which is devoted to the needs of other classes and which ordinarily should be grazed to the minimum extent practicable.

Subterranean clover is a grazing crop which gives great promise of becoming specially valuable over wide areas, and particularly so on soils of medium to poor fertility. This is well illustrated on the western sandy coastal belt of the Wellington Province and on the rolling heavier soils of the Manawatu.

Pumpkins have been tried with indifferent results. The quality of the feed is unquestionably good, but the appearance of the crops is deceiving in respect to their yield. Crops which were considered by farmers to be heavy ranged from about 15 tons to 30 tons an acre, whereas they were deemed to be much heavier. The pumpkin is serviceable for use before the mangel is mature.

Of maize for grain it may be said relative to Manawatu and similar districts that it is not dependable enough: this applies to varieties which are considered of early maturity, such as Minnosota No. 13, and Early Butler, as well as to other varieties. On the other hand, in warmer, more northerly districts maize is being used most successfully. The amount of experience with sugar beet, which is distinctly limited, suggests that yields are likely to be so small that the superior quality or feeding-value per ton does not compensate for the low tonnage.

Two crops that prove of special value for feeding to pigs are barley and peas: the grain from these are found to be good companion feeds for use with mangels, &c.

Barley.—In this district barley for grain has been grown principally on the rolling country on which Chevalier is most favoured for grain-production. The growers say that this is because (*a*) it is consistently a good cropper—*e.g.*, 40 bushels to 60 bushels, average, say, 45 bushels; (*b*) sowings may be at relatively late date (sowings mid-October to first week in December); (*c*) it does not "shake" even if allowed to become practically ripe before cutting. This is a distinct advantage, because it allows of cutting with a mower and early subsequent saving as hay. On the richer level country good results have followed the use of Cape barley.

Peas.—The preference is for Grey Partridge as a more consistent cropper than Blue Prussian, which is considered to have a greater tendency to stalk-production in showery weather.

For pig-keeping both barley and peas call for no special equipment They may be cut with mower, stacked as hay, and threshed by pigs. This is of much moment, as special outlay in equipment is thereby obviated.

The position as described above is summed up in the following statements:—

(1) Pastures suitably managed have proved of outstanding value in pig-keeping.

(2) Often the feed available from pastures becomes unduly scant at certain periods of the year.

(3) A wide range of special crops, such as mangels, carrots, swedes, barley, and field-peas, has been found to be of distinct value in pig-keeping in supplementing the feed available from pastures.

(4) The good feeding-value of certain bulky crops, such as swedes and mangels, lies in the fact that they are diluted concentrates.

(5) The economic advisability of using special crops in pig-keeping depends on the cost of producing them, and this in its turn varies greatly from farm to farm; hence each farmer's decision must be based on consideration of his own particular circumstances.

(6) In assessing the cost of special crops care should be taken to avoid the inclusion of fictitious items of cost originating in overlooking the fact that the farm as a whole is the working-unit.

TUBERCULOSIS IN FARM ANIMALS.

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TUBERCULOSIS is a contagious disease characterized by the formation of tubercles or small nodules in the affected body tissue, these tubercles being formed by the action of the causal organism commonly known as the tubercle bacillus.

Along with other bacteria such as streptococci and staphylococci, the tubercle bacilli represent a group of very lowly vegetable organisms.

Horses, cattle, sheep, pigs, dogs, cats, and poultry are all susceptible to the ravages of this disease in varying degree, cattle and pigs being the stock among which tuberculosis is most common.

Tuberculosis is a disease of the greatest importance, not only from the fact that it causes serious loss to many farmers whose stock are affected, but also because, owing to its marked prevalence in cattle, there is grave risk of the disease being communicated to mankind through the ingestion of milk drawn from infected cows.

The danger incurred to the human being through the consumption of tuberculous meat is largely overcome in the process of cooking, apart from the fact that it is an offence to knowingly allow diseased meat to be used for human consumption.

From very early times animal tuberculosis was considered to be communicable to man, rules for preventing the ingestion of infected flesh occurring in Mosaic laws.

It has been suggested that infection with the bovine type of the tubercle bacillus confers an immunity on the human being so that he is more able to withstand the evil effects of infection with the human type, but surely the better plan is to act so that the human family, in the shape of the young child, shall not be given the opportunity of becoming tubercular from either source.

There are many diseases of stock which defy the greatest efforts of elimination, mammitis and abortion being two well-known instances, but tuberculosis is just one that could be eradicated from our herds in course of time by testing and culling.

In many districts the various farmers lose only an odd cow every year or two, or even far less often than that, and are not alarmed by the occasional loss, but in some districts the disease assumes quite large proportions and occasions serious loss by the condemnation of stock both on the farm and in the slaughtering establishments.

At the moment pig-raising is receiving increased attention in this country, and many farmers have spent much money and time on it, but very few can be sure that they are not laying the foundation for wholesale condemnation of their pigs at the freezing-works because of the possible use of infected milk given morning and evening.

The United States of America has tackled the control of tuberculosis in live-stock, and is doing wonderful work in gradually getting rid of the scourge, the remarkable point being that other countries did not take similar steps long ago.

When it is known that English and Scottish research demonstrated that of 365 children under five years of age affected with tuberculosis, over half these cases yielded the bovine type of bacillus, it seems that at least all herds supplying milk to households should be tested, and the possible cause of suffering to so many should be removed. It has been estimated that in England and Wales there are 4,000 fresh cases of infection with the bovine bacilli every year, and some 2,000 deaths annually occur in human beings.

Many of the English County Councils now have veterinarians on their staffs mainly for the purpose of examining cows. These men undoubtedly do good work in the elimination of detectable cases of tuberculosis, but the testing and eradication of all infective animals is surely the only way to successfully combat this disease.

Fifty-three years ago Koch discovered the specific micro-organism which causes tuberculosis, and from then up to the present time workers have been engaged in the investigation of the disease in all its aspects.

The geographical distribution of tubercle is world-wide, its prevalence apparently being unaffected by climatic influences. Jersey cattle are said to be free from infection when in their native country, but, when exposed to infection, they succumb as do all other breeds.

In days gone by hereditary transmission was regarded as an important etiological factor in the occurrence of the disease under consideration, but it is now known that the hereditary nature of tuberculosis may practically be neglected, exceptionally few animals being infected at the time of birth.

The tubercle bacillus is regarded as an obligatory parasite, which implies that it does not multiply outside the animal body. This is a very fortunate characteristic for us all, because it allows the spread of the disease to be controlled far more easily than if the organism led a saprophytic existence and was able to multiply its species in soil or pasture.

Another important feature in the control of this disease is that exposure to sunlight destroys the bacillus in a matter of some hours: thus the organism does not maintain its vitality and its infective power for a lengthy period on pastures fully exposed to the sun. Recent research, however, has shown that tubercle bacilli are extremely resistant to the external conditions, virulent organisms having been recovered from cow-manure for a period of more than two years. This would indicate the advisability of frequent harrowing and breaking up all clods of manure on the pastures in order to let the sunlight do its beneficial work in this direction. Advice is given not to allow pigs to run in paddocks grazed by cattle infected with the disease, for the reason that the pigs may contract the disease by rooting about even though cows have not been in the paddock for some considerable time.

The small paddocks in which pigs are now frequently kept are splendid from this point of view, but it must be remembered that calves which may be drinking infective milk should not be allowed in the pigs' pens.

Pigs may also pick up the bacillus from pasture or ground over which tuberculous poultry roam, and therefore these two species of animals should not be allowed to run together if tuberculosis is suspected amongst the poultry.

In some parts of England it has been estimated that about 40 per cent. of the dairy cows are tuberculous, but in New Zealand the position is much more fortunate, this smaller occurrence probably being largely brought about by the open-air living and the abundant sunshine enjoyed by our stock but not appreciated by the tubercle bacillus. The administration of the Stock Act has undoubtedly played its part in the prevention of spread of this disease. The enlightenment of the farmer and his knowledge concerning tuberculosis, combined with his very sensible readiness to report and cull suspected animals, have been a most important factor in the suppression of what might have become a far more serious problem had the owners of our herds been apathetic and negligent in this matter.

Three different types of tubercle bacillus are known to and can be identified by the bacteriologist, these types being the human, the bovine and the avian type.

The various distinguishing features need not be recounted here, but it might be interesting to mention that inoculation into a calf will distinguish the bovine from the other two types by the acute and progressive lesions set up in the calf by the bovine bacillus. The fowl is very suspectible to the avian type, but is rarely affected by the human or bovine type. Our fireside companion, the cat, is particularly resistant to the human and avian types, but will readily contract generalized tuberculosis when inoculated with the bovine strain. Man's best friend, the dog, is markedly resistant to all three types of the micro-organism which causes this serious affection. Horses and sheep are so rarely affected that the disease in these animals merits very little attention by inspecting officials or by the general public.

Regarding tuberculosis in the dog, Henry Gray, who had a vast experience of work among dogs in London, wrote: "It is not a rare disease in the dog, although it is encountered in him less frequently than in the cat. Very frequently it has silently progressed to an extensive degree before the animal shows any serious manifestations of its ravages, and in many instances it is not suspected until a post-mortem examination is made. From a public health point of view it is important to recognize the disease early, as it may become a dangerous menace to the health of human beings in contact with such animals." He further states that raw meat or offal or unboiled milk from tubercular animals are possible sources of infection, but he believes the commonest source is that from mankind.

From observations made by a clinician such as Gray, it is apparent that infection from man to dog or cat is feasible, and that the possibility of infection passing from the animals to those who handle them is not wholly negligible. In this country, however, tuberculosis of the dog seems to be rare.

The common channels of infection of stock are the mouth and the nasal passage, the tiny bacilli, which measure about one-eight-thousandth part of an inch in length, gaining entrance to the alimentary canal with the food, or to the respiratory system during inhalation of infective air.

In the case of calves and pigs the milk from infected cows is undoubtedly the chief agent by which tuberculosis is spread amongst these animals.

One striking instance of the danger of virulent milk occurred locally in which every calf in a large herd was infected. In this outbreak some calves died and some were seriously affected, but the whole lot had to be disposed of. This loss to the farmer was probably due to one or more cows having tuberculosis of the udder, large quantities of virulent bacilli thus gaining entrance to the alimentary canal of the calves by way of the milk. This loss could have been avoided.

At slaughtering-places large numbers of pigs are found to be tuberculous, and many have to be condemned either wholly or partially in consequence; thus it behoves those who feed pigs or calves to take some steps to prevent wholesale infection of these young stock.

Undoubtedly the best way to tackle this question is to have all dairy cows tested and the reactors culled, but some method of pasteurizing the milk as it comes from the separator would overcome the danger until the time when the eradication of tuberculosis from our herds is undertaken. A pasteurizing plant of this nature would have to be cheap and efficacious; but it has been found that a combination of these two attributes is not an easy matter in this instance because of the quantity of heat required to raise the temperature of the milk to pasteurization point.

A striking object-lesson in the value of giving pigs milk free from virulent tubercule bacilli was seen by one farmer many years ago in this country. He installed a plant for pasteurizing his separated milk before feeding it to his pigs. He obtained a pasteurizer, but unfortunately this, owing to the ineffectiveness of his factory boiler, did not give satisfaction in working and it was removed, a system of heating the milk by direct steam being substituted. This did not enable him to raise the temperature to the standard accepted as necessary, but it was held at a lower temperature for a considerable time. Even with this inadequate appliance the results were most startlingly gratifying.

Of 223 pigs killed just before the pasteurizer was installed there were 154 found to be infected, but of 104 pigs killed when the milk had been rendered practically harmless there were found only three pigs with tuberculosis and two of these were very slightly affected.

If a farmer has a large percentage of his pigs rejected on account of tuberculosis at any slaughtering establishment he should take measures to prevent a recurrence of such loss. These measures may be simply a clinical examination of his cows and sows, coupled with the culling of affected animals, and further examination of any showing suspicious symptoms, or they may involve the testing of the cows and the sows.

It cannot be too strongly stressed that if the milk fed to pigs were free from virulent bacilli the condemnations of pork and bacon carcasses would fall to a figure very much more satisfactory to the farmer and to the country generally.

Most farmers are able to recognize a tuberculous cow, but the common symptoms or clinical manifestations of this disease in

cattle may be stated briefly as follows: (1) Persistent cough; (2) enlargement of a lymphatic gland; (3) general unthrifty appearance. A beast may exhibit one or all of these symptoms according to the nature and location of the disease in the particular case.

If the enlarged gland is situated inside the throat a distinct roaring noise is often discernible when the animal inspires. The other situations in which glands may commonly be seen affected are below the ear, on the shoulder, in the loose skin just where the thigh and flank are adjacent, and in the upper posterior part of the udder, the glands in these locations being sufficiently superficially placed under the skin to be noticeable when enlarged.

Unfortunately tuberculosis of the udder develops in a slow insidious manner, a hard and painless swelling later appearing in one or more quarters, while, at an early stage in the course of the mammary affection and while the milk appears quite normal, tubercle bacilli are being excreted in the milk. Therein lies the danger to the human subject, to the calf, and to the pig. In this connection it must not be forgotten that milk may be contaminated from the droppings which have adhered to the hind quarters or tail of a cow.

Diagnosis of tuberculosis in the live pig is not usually an easy matter, probably the most characteristic symptom being a swelling in the region of the throat, when the submaxillary glands may be found enlarged. In the case of sows the udder should be examined. In one seriously affected litter of pigs the brain material became the seat of tubercular lesions, which caused the young swine to stagger about as though intoxicated.

Amongst poultry, tuberculosis is a fairly common complaint, and may be met with in fowls, turkeys, parrots, and other birds. The symptoms in a fowl are not always characteristic, but general debility, anæmic wattles and lameness may suggest tuberculosis. The lesions in poultry are mostly confined to the digestive apparatus. the liver presenting numbers of yellowish-white nodules. A tuberculous lesion of the foot of the fowl is popularly known as "bumble-foot."

In parts of the United States of America where the poultry and swine industries are very great, avian tuberculosis exists to a considerable extent. It has been estimated that perhaps 90 per cent. of the swine that show symptoms of tuberculosis on autopsy originate in the section of the country where the avian type is prevalent. It will thus be seen that tuberculosis of the fowl is of some importance, more especially in connection with the pig industry.

Just lately the process of immunization of calves has been brought to public notice on account of the trial with Sphalinger's vaccine in Northern Ireland. Presuming that this vaccine, or any other vaccine, can be manufactured and used economically in the future, there are still thousands of cows in the country which are a potential source of infection to pigs, calves and other cows, and these dangerous cows should be removed from the herds.

A report of the special committee on tuberculosis submitted at the annual meeting of the American Veterinary Medical Association in 1935 illustrates the stupendous amount of work undertaken in connection with the live-stock in that country. This ambitious scheme calls for the expenditure of a colossal amount of energy, time, and money. Nothing daunted by the formidable nature of the task, the United States veterinary authorities are determined to accomplish it, and figures show how far they have succeeded.

The report states that during the year ended June, 1935, the number of cattle tested was over twenty-five million. Of this number 1·5 per cent. reacted to the tuberculin test and were removed from the herds.

The result of these indefatigable labours will ensure a freedom from bovine tuberculosis among the human and animal population, and will, in the end, provide a guarantee of the soundness of edible animal-products in America which will be the envy of the rest of the world.

New Zealand could not put forth such gigantic effort as has been demonstrated in America, and, naturally, it would not be required; but it might be possible in the near future to carry out some plan of elimination in certain areas as a preliminary step to greater things.

EXPERIMENTS WITH TWO ORGANIC-MERCURY SEED DUSTS.

AGROSAN G AND CERESAN (U.T. 1875).

J. C. NEILL, Field Mycologist, Plant Research Station, Palmerston North.

THE experiments detailed below were designed to provide information on the effect of the two organic-mercury seed dusts at present available in New Zealand, Agrosan G and Ceresan (U.T. 1875), on seed of wheat, barley, and oats in regard to plant establishment and control of disease.

Naturally infected samples of Solid Straw Tuscan wheat, Cape barley, and Algerian oats were divided into three parts—one dusted with Agrosan G, another with Ceresan (U.T. 1875), both at 2 oz. to the bushel, and the third left without treatment. Four-rod rows of 100 seeds each were sown from each lot, at approximately weekly intervals, from early autumn to late spring, in three plots of varying-soil type on the Plant Research Station, Palmerston North.

Germination counts were made when the plants were about 4 in. above ground, and the percentage of smutted plants observed when mature. The figures given in the accompanying table of results represent the mean percentage from sowings on three plots, 1,200 seeds.

No measurable differences in vigour could be detected at any stage between the plants from the dusted and those from the undusted seed. Weather conditions were most unfavourable during the spring sowings, and the germination figures are in consequence abnormally low.

Mean Results of Sowings at Weekly Intervals on Three Plots at the Plant Research Station, Palmerston North, 1935.

Date Sown.	Wheat.						Barley.						Oats.								
	Check.		Agrosan G.		Ceresan.		Check.		Agrosan G.		Ceresan.		Check.			Agrosan G.			Ceresan.		
	Germ.	Smut.	Germ.	Smut.	Germ.	Smut.	Germ.	Smut.	Germ.	Smut.	Germ.	Smut.	Germ.	Smut.	Stripe.	Germ.	Smut.	Stripe.	Germ.	Smut.	Stripe.
May 9 ..	77	10·9	77	..	72	..	72	0·53	70	..	72	..	85	0·8	14	83	0·1	3·3	85	..	..
„ 16 ..	67	7·7	84	..	71	..	81	0·43	86	..	85	..	77	0·3	7	92	..	0·3	96	..	..
„ 25 ..	61	15·4	75	0·1	69	..	76	0·3	82	..	80	..	82	0·9	13	86	0·3	2·7	87	..	..
„ 30 ..	77	9·8	79	..	85	..	80	0·2	84	..	85	..	86	1·2	9	90	0·8	1·4	89	..	..
June 7 ..	62	5·1	70	..	75	..	70	0·3	76	..	77	..	79	0·4	14	91	0·1	2·9	93	..	..
„ 13 ..	73	2·7	72	..	75	..	69	..	79	..	78	..	84	0·6	9	89	..	2·7	89	..	..
„ 20 ..	61	10·2	63	0·2	56	..	63	..	66	..	58	..	69	0·1	9	85	..	0·9	82	..	..
„ 27 ..	51	4·3	61	..	57	..	62	0·1	67	..	66	..	69	0·5	9	80	..	0·7	81	..	..
July 4 ..	61	10·4	68	0·1	66	0·1	59	0·27	60	..	58	..	65	0·6	9	71	..	2·7	72	..	0·1
„ 11 ..	52	13·3	62	..	62	..	53	..	56	..	58	..	63	0·3	10	65	0·3	2·7	63	..	..
„ 17 ..	56	8·4	64	0·2	66	..	57	0·1	56	..	58	..	69	0·1	15	73	..	3·3	70	..	0·1
„ 25 ..	39	8·3	47	0·5	47	0·1	33	..	36	..	40	..	47	1·1	13	51	..	3·3	56	..	..
Aug. 1 ..	41	4·4	47	0·3	49	0·2	45	0·7	46	..	55	..	64	1·0	8	71	0·1	1·3	67	..	..
„ 8 ..	29	1·9	37	..	35	0·4	28	0·37	28	..	28	..	35	0·7	7	38	0·1	1·0	42	..	..
„ 15 ..	20	3·5	30	..	32	..	31	0·33	37	..	35	..	43	0·1	5	53	..	0·8	50	..	..
„ 22 ..	17	8·0	34	..	28	..	34	0·6	32	..	36	..	41	0·8	8	46	0·4	1·3	37	..	..
„ 29 ..	46	3·1	46	..	52	..	31	0·6	45	..	49	..	62	0·8	7	65	..	2·0	71	..	..
Sept. 5 ..	40	0·3	48	..	50	..	47	1·33	51	..	45	..	65	1·4	8	76	0·4	1·3	73	..	..
„ 11 ..	28	0·7	41	..	47	..	45	0·50	50	..	49	..	68	1·7	7	74	0·1	1·3	76	..	..
„ 19 ..	23	..	28	..	23	..	21	..	24	..	22	..	50	1·3	10	49	0·3	2·3	56	..	..
Mean ..	49·1	6·4	56·6	0·06	55·8	0·04	52·8	0·33	56·5	..	56·7	..	65·1	0·7	9·5	71·4	0·15	1·9	71·7	..	0·01

SUMMARY OF RESULTS.

Taking a general mean of twenty weekly sowings, each of three plots, dusting wheat-seed with Agrosan G at 2 oz. per bushel increased plant establishment over that of the untreated seed by 15 per cent., barley-seed by 7 per cent., and oat-seed by 9·5 per cent. The corresponding figures for Ceresan (U.T. 1875) were 13·6 per cent. with wheat, 7·4 per cent. with barley, and 10 per cent. with oats. With wheat and barley the increased establishment following dusting was about three times greater in the lower ten mean germinations than in the upper ten, but with the oats the differences were about 10 per cent. greater in the upper ten means than in the lower.

Stinking-smut of wheat was reduced from 6·4 per cent. in the untreated seed to 0·06 per cent. with Agrosan G and to 0·04 per cent. with Ceresan (U.T. 1875). With barley the untreated seed produced 0·33 per cent. of covered-smut and the Agrosan G and Ceresan dusted seed none. An incidence of 0·7 per cent. of smutted oat-plants with the untreated seed was reduced to one of 0·15 per cent. by Agrosan G, and to none by Ceresan.

Oat-seedlings showing symptoms of stripe disease were reduced from 9·5 per cent. to 1·9 per cent. by Agrosan G and to 0·01 per cent. by Ceresan.

DRY MASH *versus* WET MASH.

FOR FEEDING OF CHICKS IN BROODER.

W. L. JOURDAIN, Poultry Station, Department of Agriculture, Wallaceville.

DURING the months of September and October of the 1935 breeding-season an experiment was carried out at this Station for the purpose of ascertaining the relative merits of wet-mash and dry-mash feeding for growing chicks. The chicks which took part in this experiment were from a batch of sexed pullets, there being 102 pullets in each pen.

The brooder used was a Beck's electric brooder, which was divided equally into two pens by a partition. This enabled both lots of chicks to be reared under exactly the same conditions.

Pen No. 1 was fed with the ordinary wet-mash ration, which is that fed to all chicks reared at this Station. Pen No. 2 was fed with a dry-mash mixture, which was before the chicks all the time.

The experiment commenced on the 2nd September and ran for six weeks, finishing on the 14th October.

The chicks in both pens were weighed before being put under the brooder and were thereafter weighed on the seventh, fourteenth, twenty-first, twenty-eighth, and forty-second days. Table II gives the results of the weighings.

Pen No. 1 (Wet Mash).—These chicks were fed a grain-mixture of three parts finely cracked wheat and one part maize for the first week. They received four meals per day at the commencement until they were all eating, when the meals were reduced to three a day, which were fed at the hours of 7.30 a.m., 11.30 a.m., and 4.30 p.m. The amount of grain intended for each meal was first soaked with skim-milk for about an hour to allow it to swell.

From the eighth day the chicks were given two mash-meals and one grain-meal per day, the mash-meals being fed at 7.30 a.m. and 11.30 a.m., and the grain-meal at 4.30 p.m.

The mash-meals consisted of equal quantities of bran and wheat-meal, the amount of bran being slightly less than usual. It was found that the chicks were leaving a little, thus necessitating the reducing of the proportion of bran in the mixture until there was no wastage. This mixture was then fed right through the test, except that 3 per cent. of meat-meal was added after the fourteenth day. The meals given to Pen No. 1 were mixed with skim-milk, and water was given them to drink. Included in the feeds for the first four days was approximately 1 per cent. of fine oyster-shell grit, and from the fourth day onwards this oyster-shell grit was always before them in an open hopper allowing them to consume as much as they required.

After the fourth day the chicks were given young green oats and silver beet, finely cut up, and this green food was fed separately between the meal hours at 9 a.m., 2 p.m., and, after the last meal, at 5 p.m.

Pen No. 2 (Dry Mash).—The chicks in this pen were fed with a mixture of dry mash (see Table I) throughout the test, and they were given skim-milk to drink from the start. With the exception of these two differences they had exactly the same treatment as the chicks in Pen No. 1. They were fed a little scratch grain (see Table I) at 5 p.m. to encourage them to work; but it was noticed that they never at any time appeared ravenous for it.

The mash and grain mixtures for Pen No. 2 were made up as follows:—

Table I.

Mash.	Grain.
40 lb. ground maize (maize-meal).	75 lb. (three parts wheat).
20 lb. bran.	25 lb. (one part maize).
14 lb. pollard.	
10 lb. ground oats (not oat-meal).	100 lb.
84 lb.	

Observations.

During the test it was noticed that although the chicks in Pen No. 2 (dry mash) had good colour in their legs it was never at any time as deep a yellow as the colour in the legs of the chicks in Pen No. 1 (wet mash). As far as could be seen, there was little, if any, difference between the two pens in respect to feathering.

As will be seen from the accompanying table of weights (Table II), there was practically no difference between the aggregate weights of the chicks in the two pens right throughout the test. Up till the fourth week the chicks in each pen were individually fairly even in size, but from then on there was a decided difference. While the chicks in Pen No. 1 continued to grow steadily and evenly, the chicks in Pen No. 2 began to grow unevenly, for while some of them grew exceptionally quickly, growing bigger than the chicks in Pen No. 1, the remainder seemed to be at a standstill.

There was a big difference in the amounts of liquid consumed in the pens. The chicks in Pen No. 2 drank almost twice as much as those in Pen No. 1. This difference would be, to some extent, owing to

Pen No. 2 having the dry mash and also to the fact of its having skim-milk to drink, while Pen No. 1 had water and the mash already being moistened would necessitate less to drink.

The following tables give details of weights of chicks and the classes, amounts, and cost of foods used for each pen during the experiment :—

Table II.—Weights of Chicks.

Number of Chickens.	Age.	Weight.		Average Weight.
TEST I : PEN NO. 1 (WET MASH).				
	Days.	lb.	oz.	oz.
102	1	8	8	1·33
99	14	20	4½	3·27
99	21	31	0¼	5·01
96	28	44	14¾	7·49
95	42	76	10	12·91
TEST I : PEN NO. 2 (DRY MASH).				
102	1	8	8	1·33
98	14	20	13	3·39
98	21	30	10¾	5·01
96	28	44	10¾	7·44
96	42	76	3	12·66

Table III.—Class, Amount, and Cost of Food consumed.

PEN NO. 1.

Foodstuff.	Price.	Amount consumed.		Cost.	
		lb.	oz.	s.	d.
Wheat-meal	10s. per 100 lb.	80	0	8	0
Bran	7s. per 100 lb	33	8	2	4·14
Meat-meal	8s. per hundredweight ..	3	14	0	3·321
Wheat	5s. 7d. per bushel (60 lb.) ..	68	4	6	4·212
Maize	5s. per bushel (50 lb.) ..	22	12	2	3·3
Hulled oats	5s. 9d. per bushel (40 lb.) ..	2	8	0	4·312
	Total cost for six weeks ..			19	7·285

Average cost per chick approximately = 2·401d.

PEN NO. 2.

Foodstuff.	Price.	Amount consumed.		Cost.		
		lb.	oz.	£	s.	d.
Ground maize	9s. per 100 lb.	107	0	0	9	7·56
Bran	7s. per 100 lb.	48	8	0	3	4·74
Pollard	6s. 6d. per 100 lb. ..	36	8	0	2	4·47
Ground oats	15s. per 100 lb.	24	4	0	3	7·65
Meat-meal	8s. per hundredweight ..	5	12	0	0	4·928
Wheat	5s. 7d. per bushel (60 lb.) ..	18	8	0	1	8·658
Maize	5s. per bushel (50 lb) ..	6	0	0	0	7·2
	Total cost for six weeks ..			1	1	9·206

Average cost per chick approximately = 2·665d.

NOTE.—The average number of chicks in each pen was ninety-eight for the whole period of the experiment.

Influence of Feeding on Minerals in Blood and Bones.

When the chickens were four weeks old, and again when fourteen weeks old, two birds from each pen were delivered to the Veterinary Laboratory for analysis. Table IV contains the resultant data supplied in the report of Dr. Hopkirk, Officer in Charge of the Veterinary Laboratory.

Table IV.

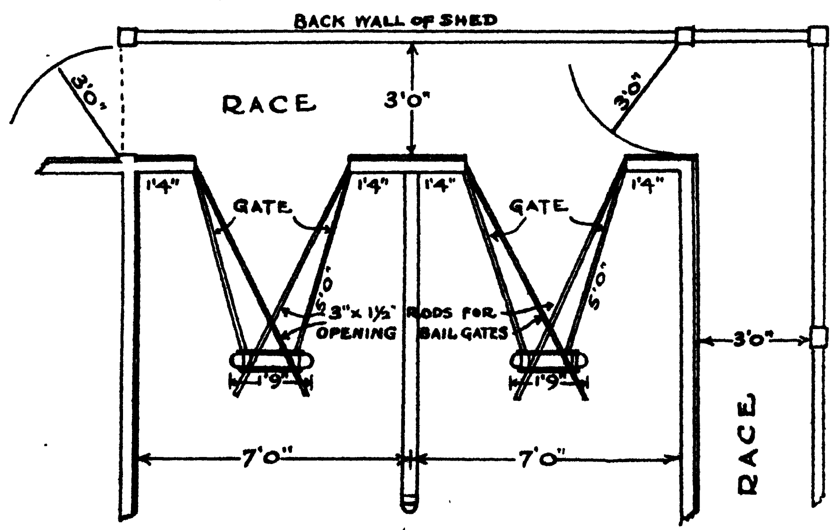
—	Blood (Calcium).	Blood (Inorganic Phosphorus)	Bone Ash.
			Per Cent.
30th September—			
Wet mash (average of two birds) ..	9·2	6·7	46·5
Dry mash (average of two birds) ..	10·0	5·5	43·9
12th December—			
Wet mash (average of two birds) ..	11·6	4·7	47·3
Dry mash (average of two birds) ..	11·6	5·8	47·3

The values for blood calcium and inorganic phosphorus are given in milligrams per 100 c.c.

No significant differences exist between the groups and all values lie within normal limits for birds of that age.

A MODIFICATION OF THE WALK-THROUGH MILKING-SHED.

The modification of the walk-through milking-shed which is described herein developed in two stages, the first having been used in the Waikato about the year 1930. It consisted of hinged sides on the "dummy" and an opening at the back of the "dummy" through which both cows passed out on to the exit race.



A MODIFICATION OF THE WALK-THROUGH MILKING-SHED.

Sheds of this type were very cold and draughty during the spring and winter months, and the plan shown with the enclosed race came into use in the Manawatu district where it is now very popular.

The stall shown has a number of advantages. A feed-box can be built in at the head of the cow. The stall being wedge-shaped holds the cow more securely, which is quite an advantage with young heifers. The outlet is wider when the cow is going out. There are no doors extending into the race.

Prints of this plan which can be used as a modification of the standard plan provided by the Department are obtainable on application to the Director, Dairy Division, Department of Agriculture, Private Bag, Wellington, or from officers of the Division.

—Dairy Division.

DAIRY FACTORIES (LICENSING) REGULATIONS, 1936.

By the above-entitled regulations the Dairy Factories (Licensing) Regulations, 1935, are revoked and new regulations substituted. Except as indicated herein the new regulations incorporate the provisions of the regulations which have been revoked.

The directions in which the former regulations governing the licensing of dairy factories have been modified, amended, or extended are as follows:—

1. To include within the scope of the licensing provisions premises the plant erected in which is after 5th March, the date of the coming into operation of the new regulations, so altered or extended as to increase the manufacturing capacity of the premises.

2. To provide that portion of the cost of any investigation made by a committee in respect of an application for a license referred to it for that purpose shall be borne by the applicant, who shall be required to lodge security for the payment of such costs. An applicant for a license is required to bear the costs of the investigation not exceeding £50 if the report of the committee is unfavourable or if the committee recommends the grant of a license to an extent not substantially greater than the extent to which the Director of the Dairy Division may have previously intimated to the applicant that he was prepared to grant a license. A certificate of the Director as to the costs of any investigation shall be final and conclusive in all respects, and any dispute as to whether the recommendation of a committee is that the application should be acceded to to an extent substantially greater than any intimation previously given by the Director indicating his willingness to grant to the applicant a license in part only shall be referred to the Executive Commission of Agriculture, whose decision shall be final and conclusive in all respects.

3. To include power to insert in a license conditions limiting the quantity and kind of dairy-produce that may be manufactured in licensed premises, and restricting the purpose for which the premises may be used.

4. To provide that any license already granted which contains any condition of the kind referred to in the last paragraph shall be valid.

5. To provide for the revocation of licenses in any of the events set out in clause 11.

6. To provide that alterations or extensions of plant and buildings in respect of licensed premises shall be made only with the prior approval of the Director of the Dairy Division, who may, in a proper case, refer any application for approval to a committee for investigation. All the provisions of the regulations relating to applications for licenses, powers of investigation by a committee, and apportionment of the costs of any investigation apply to any such application as if the application were an application for a license.

7. To authorize payment of a fee not exceeding £2 2s. per day to members of a committee for their services, together with all reasonable and actual expenses incurred by them in investigating and reporting on an application referred to the committee for that purpose.

—A. E. Morrison.

SEED-WHEAT CERTIFICATION.

CERTIFIED CROPS.

UNDER the Government scheme for the certification of seed wheat the following growers have seed for sale from crops which have passed both field and grain inspections. (A previous list, to which purchasers are also referred, was published in the March *Journal*.)

Variety.	Grower.	Acreage.
Cross 7	*R. and P. Campbell, Kingsdown, Timaru ..	30
	C. A. Campion, Mount Hutt R.D., Methven ..	5
	*M. P. Daniel, Kingsdown, Timaru	9
	G. Farquhar, Mount Hutt R.D., Rakaia ..	18
	*A. Jackson, Otipua, Timaru	17
	*Mrs. L. E. Johnston, Rosewill, Timaru ..	16
	*W. C. Lowery, Winchmore R.D., Methven ..	26
	J. R. McCulloch, Ngapara, Oamaru.. ..	8
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* Passed subject to machine-dressing of seed.

—*Fields Division.*

SEASONAL NOTES.

THE FARM.

Pre-winter Top-dressing.

In many districts the abnormal rainfall of the expired portion of the current calendar year has given, at this season, a feed position very different from that obtaining widely at the corresponding period last year, when stock had just come through a period of markedly low rainfall and of scant supplies of feed. Just how farm practice should be adapted to the present position is a question which needs to be solved for each particular set of conditions and about which no specific guidance generally applicable can be given with any great safety. In some instances feed is so abundant and growth of pastures continues so vigorously that the benefit to be obtained from pre-winter top-dressing is not so apparent as it normally is. On the other hand, farms on which pre-winter top-dressing well may be expected to prove profitable are far from uncommon ; included in some of these farms are ones on which stock have been carried in sufficient numbers to make effective direct use of all the feed that has become available and others on which the reserves of feed for use in late winter and early spring are not as great as it would be advantageous to have them.

In regard to those farms on which pre-winter top-dressing is advisable, it should be kept in mind that the period during which the fullest benefit is obtainable from such top-dressing is drawing to a close, and especially in the colder districts any considerable delay in carrying it out should be avoided as far as possible. If top-dressing is not carried out until close to the season when the growth of grass is at its lowest point, then the top-dressing approximates in its effect to spring top-dressing, and some of the value of pre-winter top-dressing is lost : much of this value lies in the fact that quickly acting phosphates applied in April or May usually bring about an almost immediate increase in the rate of grass-growth, an increase which commonly is of value in carrying stock along in good condition until adequate spring feed becomes available For pre-winter top-dressing it is advisable to select pastures which are relatively well drained, well sheltered, and rich in rye-grass. Such fields are better fitted to respond satisfactorily to stimulation during the cold season. Especially in sheep-farming, pre-winter top-dressing is at times particularly desirable, because the dressing of broken or rolling country tends to be more difficult and costly after winter rains have made the land soft.

The current position may be summed up by saying that the cases in which the abnormal season has made pre-winter top-dressing inadvisable when it would be advisable in a normal season are relatively few, and certainly fewer than at first thought they might seem to be, particularly if the current wide-spread abundance of feed is allowed to impress one unduly. The crux of the position lies in the well-established fact that usually the supplies of feed for winter and early spring are greatly below the economic needs of our live-stock, and a combination of favourable seasonal conditions and judicious top-dressing such as is normally advisable may be expected merely to raise the feed supply nearer than it generally is to the level fixed by the amount of feed that the stock can utilize profitably.

Liming of Grassland.

In localities in which beneficial results are obtained from liming of grass-land, success has attended the application of the lime in April and May. Whether better results are obtainable from applying the lime at any other season is a question about which little or no recorded conclusive experience

is available. Probably in the first place liming in April and May was practised because of its convenience due to the fact that commonly there is no marked pressure of work at this season, and, having proved satisfactory, has been continued. A limited amount of investigation throwing some light on this matter which has been carried out suggests, though it does not definitely establish, that liming at other seasons will not prove more effective than liming about April or May.

In regard to an extensive series of field trials which have been carried out throughout the Dominion during recent years, the 1935 annual report of the Department of Agriculture states :—

> "The survey of the response of New Zealand grassland to various classes of fertilizers and to lime is a task of major importance which has already provided practical guidance of considerable moment. For instance, it throws useful light, possibly unexpected by many, on the variations in the response of grassland to lime from district to district. It would seem that some farmers err by spending money on lime and others by not spending enough money on lime."

In the same report, relative to the record amounts of lime carried by rail during the previous year, it is stated :—

> "If it were certain that the lime-supplies were being used where farm experience and investigation have shown that they are productive of profitable results, then the recent increases in the amount of lime handled would be a matter for congratulation, but when the railage destinations of certain substantial supplies are checked against the results of field trials and veterinary experience it seems that lime is at times being used increasingly without any evidence that would justify recommending its use. From the available evidence it seems probable that some districts with advantage could use greater quantities of lime than are being used, while in other districts the outlay now made on lime could be made more profitably in other directions—e.g., in the use of phosphates."

Further interesting information about the use of lime is contained in articles by M. C. Franklin and J. W. Woodcock in this *Journal*, November, 1935, and January, 1936, respectively. These articles taken together indicate that some of the views about lime most deeply rooted and most widely accepted are to be viewed as belief rather than as knowledge, and they support the statements quoted above in making clear the advisability of obtaining authoritative information about the benefits obtainable from liming before embarking on any considerable outlay on lime for use on grassland, particularly if such an outlay is to result in a reduced outlay in phosphates.

Approximately 2 tons of ground limestone are equivalent in their ultimate influence on the soil to 1 ton of burnt lime (100 lb. of ground limestone is equivalent to 56 lb. of burnt lime when both are pure). As a general rule, considering only the effect on the soil, it is not of material importance whether ground limestone or burnt lime is used provided the dressings of ground limestone are about twice as heavy as those of burnt limestone. Hence their relative costs should determine which of the forms of lime should be used. Certain special circumstances may justify departure from this rule. For instance, if speedy action is desired, as in the removing of soil-sourness for the better control of crop-disease such as club-root, then burnt lime should be used. Again, the cost of transport and handling as distinct from the cost of the material, if relatively heavy, may make burnt lime preferable. Indeed, especially when the land is not particularly in need of lime, the costs of handling and transport are at times so heavy as to make expenditure on liming either not worth while or not so profitable as expenditure on other top-dressing material such as phosphates.

Ordinarily, supplies of lime in the soil tend to be depleted because the lime is washed down and leached away. Hence the working of lime into the soil is to be avoided usually, as it is simply a means of hastening loss. The present practice in liming tends towards relatively small dressings, say, 3 cwt. to 5 cwt. an acre, repeated at comparatively short intervals

instead of the heavy dressings at long intervals which were more common in years past; it is to be noted, however, that in Otago and Southland comparatively heavy dressings of 15 cwt. to 25 cwt. an acre are still most popular.

It is exceptional for lime alone to give good results, and generally the best returns from liming are obtainable from the use of lime and superphosphate together. Indeed, a poor result from superphosphate alone is an indication of a probable profitable response from lime used in conjunction with superphosphate.

To sum up two important features of current liming practice, (1) there is failure to use lime adequately on a substantial number of farms which would respond profitably to free use of lime; (2) there is replacement of phosphates partly or wholly by lime on farms about which there is no evidence that liming is economically sound. Farmers who have not definite knowledge of the effect of lime in their district may obtain all available facts from local officers of the Fields Division.

Harrowing of Pastures.

Knowledge of the undoubted value of harrowing at this season pastures on which animal droppings have accumulated is widespread. Nevertheless, frequently such harrowing is not carried out. This is due at times to the fact that the extent of the difference between harrowed and unharrowed pastures otherwise similarly treated is far from fully realized; undistributed droppings mean subsequent development of rank patches of growth with which is associated probability of pasture-deterioration, whereas when the droppings are distributed thoroughly and without overmuch delay the development of rank growth is obviated and the pasture as a whole is improved. A more fitting appreciation of the value of grass-harrowing would obtain if those concerned kept in mind the established value of farmyard manure in European and American farming, wherein there is costly and careful provision to bring about its most effective use. On the other hand, in our farming storage of the animal manure is unnecessary, and much but not all of the necessary distribution is brought about naturally. Yet many neglect the small but relatively inexpensive attention —harrowing—which is needed here to turn abuse of the animal manure into its profitable use. The farmer who omits to do harrowing before the winter is practically sure to be faced with the task of dealing with uneven pastures in the spring—the effective grazing of such uneven pastures can seldom be carried out without " punishing " the stock in order to force them to graze the rank unattractive pastures.

Treatment of Young Pastures.

Special care in the treatment of young pastures proves profitable. The plants, having been given a fitting opportunity to establish themselves, should neither be allowed to become tall and productive of flower-heads nor be continuously eaten down closely: the latter generally is the less likely this season because of the abnormally abundant growth of feed during the summer and autumn. To keep the plants desirably short it usually is preferable to graze young pastures by a relatively large number of stock for a short time only. This avoids the relative hard grazing of the more attractive species and the neglect of other species which are apt to occur under protracted light stocking. Persistent close grazing of young pastures is especially harmful because it checks or maybe prevents the development of strong root systems, upon which the future vigour of the pasture depends. Properly controlled grazing, which not only avoids persistent close grazing but also prevents too rank a growth during the early life of the pasture, leads to stooling-out of the plants and consequently to a denser sward that more completely covers the soil. As far as is practicable, grazing of young

pastures should be avoided if the ground is soft, as it is apt to become because of rain: trampling of wet, soft ground readily leads to bare patches of soil on which weeds may become established eventually. Particularly in the case of young pastures is additional fertility due to top-dressing likely to be valuable, because during a critical stage it helps better plants needing higher fertility to struggle successfully against competing poorer species.

Provision of Feed Reserves.

It becomes advisable at this period to draw up a programme of the coming year's provision of special feed. It is quite possible that later some modification of this programme will become necessary, but radical modifications are not likely to be needed, and in the interval the programme is of value as the basis of decisions about various matters, such as the location of fences and silos and cultivation work, which should be planned now so that labour may be devoted to them from now onwards as opportunity offers.

In drafting a programme of feed-provision it is important not to depend too much on what can be provided next season by means of silage and hay from pastures unless there already exist sufficient reserves of feed to tide over the normal critical periods, even should an unfavourable season lead to but scant surplus pasture-growth for conversion into silage or hay. Ensilage is an excellent means of placing surplus grass-growth in reserve, but in many districts to count definitely on an adequate surplus being available is such a risky practice that arable cropping to give assurance of the year's provision of feed should be carried out.

In many localities, especially where the growth of grass during winter is practically negligible, autumn cultivation is valuable as a preparation for such crops as mangels, carrots, potatoes, and lucerne, and at this stage no suitable opportunity should be missed of cultivating land in May for spring sowing. Early ploughing (possibly skim-ploughing) of land for crops to be grown after grass gives sufficient time for the complete breaking-up and mixing of the sod with the remainder of the soil. This begets increased fertility, which, while generally useful, is specially valuable for potatoes and mangels. Because of the value of timely preparatory cultivation of this type, it is fortunate that lea land can at times be worked safely when adjoining similar land which recently has been under the plough is too wet.

Autumn Utilization of Crops.

Immature living organisms as a rule are tender, delicate, and less able without injury to undergo hardships to which as adults they could be subjected without permanent harm. For farm-stock winter often is a time of hardship, and calves and hoggets, because of their immaturity, are likely to receive permanent setbacks unless they receive good attention. Setbacks sometimes originate in abrupt substantial changes in feed. Such changes may be obviated by familiarizing young animals with hay, and especially with silage, when they are still in good condition and still have available other feed. Training stock to eat strange fodders before they are called upon to subsist on them wholly is generally advisable.

Hoggets, which should be given the best treatment possible, well may be given the run of any available fodder crop before they become low in condition, and, if it is possible, they should be given a run-off on a suitable pasture—one which is clean, short, and fresh, and so unlikely to be contaminated with parasites.

In the case of dairy cows much more could be done than is done usually in the way of feeding liberally during the off-season—a procedure which may be expected to react beneficially on production during the subsequent season During the season of low production the good cow naturally and necessarily builds up bodily reserves which stand her in good stead under

the drain and strain of a season of high production. She can, however, build up these reserves only if she consumes the nutriment which is needed in the creation of reserves. In practice this means that she should be well fed when she is not actually producing, just as when she is producing heavily, although, of course, the standard of feeding when she is not producing does not need to be quite as high either in quantity or quality as during heavy production. The point of practical importance, however, is that the standard of feeding advisable during the off-season profitably could be made appreciably higher than it commonly is. Frequently it has been noted of cows outstanding as producers that they displayed ability to " milk off " bodily conditions, and their high production has been linked causally with this ability. The point of practical importance is that the ability is of no avail unless in the first place the cows are fed in such a way that they are enabled to develop the condition which subsequently affects production beneficially. In short, producing-ability without good feeding during the period of low production does not take us far enough.

The trampling and firming of lucerne-fields which certainly result from grazing during autumn and winter should be avoided if at all possible, and this year especially, because of the exceptionally abundant growth of grassland, it should be possible to reduce the grazing of lucerne to a minimum, if not to dispense with it completely. Thriving lucerne is such a valuable crop that all avoidable causes of its deterioration should be eliminated as far as is practicable: autumn and winter grazing of lucerne generally is a definite cause of deterioration.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Late Harvesting.

In most commercial orchards the fruit that now remains to be harvested is the final picking of the late-maturing export varieties and the fruit which has been left to tree-ripen. Sturmer Pippins which are left to tree-ripen should be harvested before " apple-spot " develops.

Fruit held in ordinary shed storage should be sorted at intervals, and any fruit developing rots removed. Any fruit showing signs of depreciating should be marketed without delay. With care, most of the late varieties will hold satisfactorily for a considerable time in ordinary shed storage, provided the fruit has been carefully handled and graded to eliminate fruit with disease and skin punctures. Fruit held in cool store should be examined frequently, and any lines showing forward maturity marketed before condition is lost.

Late Spraying.

Following the completion of the harvesting it is advisable to spray stone-fruit at " leaf fall " with Bordeaux 5-4-50. From results observed over the past few years it is recommended that all varieties of both apples and pears likewise receive a similar spray at " leaf fall." The practice of using Bordeaux in the autumn in place of at the " green tip " period has been found in normal seasons to minimize russet greatly. If an autumn Bordeaux spray is applied it should be followed by a strong lime-sulphur spray (1 pint by volume to 15 parts water) in the spring at the " delayed dormant " period, excepting on varieties which have been badly affected with black-spot the previous season, and these varieties should receive a further Bordeaux spray at the " delayed dormant " period.

Following the autumn spray, the spraying outfit should be thoroughly cleaned, overhauled, and renewals made where necessary. The pipe-lines of stationary plants should be well flushed out. The work of overhauling the outfit is best done during the winter, when there is usually time to spare before the new spraying season commences.

Ploughing and Manuring.

Deep ploughing of the orchard at least once a year is advisable, but it should not be so deep as to cut or seriously damage the main roots. It is recommended that this ploughing be done in the late autumn, as the effect of the injury upon the tree is less should the feeding-roots be disturbed at this time of the year than when the tree is in growth.

It is also preferable in most cases to turn under cover crops which are sufficiently mature in the autumn, so that the green matter may decay before the spring cultivation commences.

Applications of phosphatic and potassic manures may be made during the autumn just prior to the ploughing of the land. Soils requiring lime may be top-dressed with approximately 1 ton of carbonate of lime per acre. The application of the quickly acting nitrogenous fertilizers should be delayed until the spring.

New Plantings.

In selecting a site for the young orchard due consideration should be given to securing good, warm land favourably situated as to aspect to sun, natural drainage, and provision of shelter.

The area intended to be set out with new plantings should be thoroughly tilled and put in fine condition. If the order for trees has not already been given no further time should be lost in placing it.

On well-drained situations in the warmer areas, the planting of trees may be commenced at the end of autumn; otherwise it should be carried out in the spring, when the land is in suitable condition. At planting the trees should receive up to ½ lb. of a phosphatic manure, to be followed in the spring with a dressing of up to ¼ lb. of nitrogenous fertilizer.

The provision of adequate shelter is of paramount importance, and it is advisable to establish shelter preferably two years in advance of setting out new plantings, so that the young plantation will not be thrashed by prevailing winds. Adequate room should be left between the shelter-belt and adjacent row of fruit-trees so that when fully grown the shelter does not overcrowd the first row.

General Work.

Before the winter rains commence all open drains should be cleaned out and the exits of covered drains opened up. Provision for new drains should be made wherever necessary. Adequate drainage is most important for the health of the trees, which cannot thrive or crop to perfection on wet, retentive soils. Each year many trees are lost through lack of sufficient attention to this aspect of orchard-management.

At the end of the harvesting and packing season the packing-shed should be cleaned up, the mechanical grader cleaned and greased, any spare packing material safely stored until the next season, and any waste and diseased fruit should be gathered and destroyed. Orchard boxes should be collected, repaired, and stacked under cover till again required. The life of the tree-props will be lengthened if they are gathered now and stored away.

—*R. G. Hamilton, Orchard Instructor, Hamilton.*

Citrus Culture.

Where new plantings of citrus trees are contemplated every consideration should be given to those factors which are important for successful establishment of the trees. It is essential that adequate shelter should be planted some time, preferably two years, beforehand, as young fruit-trees will not thrive when exposed to cold or strong winds. Where proper care is lacking during the first two or three years they will not grow into satisfactory trees. It is advisable to defer planting until the shelter has become well established.

In selecting an orchard-site only good, well-drained land with a northern aspect should be utilized. If the land is not naturally drained a system of artificial drainage should be undertaken, as citrus trees make poor progress where the soil is at all inclined to become water-logged during wet weather.

The land should be ploughed and subsoiled as early as possible prior to planting, giving a dressing of 2 tons of carbonate of lime per acre, and a cover crop sown which when it decomposes will improve the fertility and mechanical condition of the soil. If it is desired to plant out in the following spring, strips of land where the rows of trees will be planted may be left unsown.

The selection of the trees should not be overlooked. The order should be placed with the nurseryman some months before the plants are required, so as to have the order filled from the best trees available. Trees that are stunted or of indifferent quality should be rejected as they will not make satisfactory trees.

Planting may be undertaken either in the autumn or the spring, but it is only advisable to plant in the autumn in warm situations which are reasonably free from frost.

In older groves the preparation of the soil for the winter should consist of shallow ploughing so as not to cut too many of the surface roots to the detriment of the growing tree, or, as an alternative, a light disking is of value.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

The Care of Pullets.

As pullets must be depended upon to supply the great bulk of the eggs during the next few months every care should be exercised to see that they are made as comfortable and contented as possible. Nothing should be done, or left undone, that is likely to upset the laying pullets, especially at this time. It is well to remember that it is not the natural time of the year for pullets to be laying, and very little will cause them to stop producing and go into what is known as a " false " moult. Only by careful handling, good housing, good feeding, and close and regular attention to every detail can the poultry-keeper expect to secure the very best returns from his pullets during the season when eggs are scarce.

Housing.

In the past thirty years many changes have taken place as to the housing of poultry, and while the successful poultryman has proved by experience the great importance of proper housing there are still many who have the idea that all that is necessary for the birds is a shelter at night in order to protect them from bad weather. While it is a mistake to coddle poultry, the house should be looked upon as their home and playground; especially is this so where pullets are kept on the intensive or semi-intensive system.

The three essentials to good housing are plenty of room, fresh air, and dryness. The first thing to avoid is overcrowding, and each bird should be allowed at least from 8 in. to 9 in. perch room, the perches being at least 18 in. apart, and also a minimum of 4 square feet of floor space. In fact, many of the most successful intensive poultry-keepers have found that better net returns are obtained when 5 square feet are allowed each bird. If more pullets are reared than can be suitably accommodated it is a wise policy to go through them carefully and cull out all the unpromising ones, until those left can be allowed at least the floor-space mentioned. Some poultry-keepers fail to appreciate the great advantage of a regular and careful

grading-up and culling of pullets. Even in the very best of flocks there are to be found some pullets that fail to develop and mature as well as the majority, and if such birds are detected and disposed of, and the extra room, care, and feed is given to the better birds, the financial returns are likely to be better, even though fewer birds are kept.

Many plants have been visited where those late-hatched, backward, slow-growing, and poor-feathered pullets are kept just because they are pullets. It cannot be emphasized too strongly that slow growth and poor development are indications of a weakness, and such birds are really a danger on any plant, for not only are they unprofitable but very often they start such troubles as colds, worm-infestation, feather-pulling, or cannibalism in a flock.

Dampness in Poultry-houses.

Good winter egg-production can hardly be expected unless the floors of the houses are dry. Every effort should therefore be made to guard against dampness in the laying-sheds. The floor of the house should be a few inches higher than the surrounding ground, and proper drainage should be provided under the foundation. Concrete floors are recommended, and if properly made they are impervious to water. Again, the house must be properly ventilated, for if insufficient fresh air is supplied dampness may be caused by condensation. Iron-roofed houses should be lined at least over the perches in order to avoid the drops of water which fall from unlined roofs on a frosty morning.

Compelling birds to roost in poorly ventilated houses is one of the chief causes of autumn colds amongst pullets. Seldom, if ever, does one see birds that roost in trees suffering from colds, but it is a common complaint where birds are housed in poorly ventilated quarters.

It is well to bear in mind that the normal temperature of a fowl ranges from 106° to 107·5° F., thus they require plenty of fresh air in order to keep in good health and condition.

Most of the up-to-date poultry-houses are now provided with back ventilation. The amount of such ventilation needed depends upon the general construction of the house and the locality in which it is built. In most places a house 16 ft. deep by 20 ft. long is all the better for at least three back ventilators, which can be placed in the back wall between the top wall-plate and the roof, one about 1 ft. from each corner and one in the middle. The size of each opening should be at least 8 in. long by 3 in. deep, and it is well to cover them with small-mesh wire netting in order to keep out small birds.

The floor of the house should be covered with 3 in. or 4 in. of good, dry straw, in order to give the birds plenty of exercise. It is very difficult to keep the litter dry during the winter months, especially if the houses are overcrowded; but should the litter get damp and start to give off an adour it must be renewed.

As the pullets come on to lay it is a good practice to handle a few each week in order to ascertain their condition. Should they appear to be losing weight it is advisable to slightly increase their food-supply, especially their grain ration.

While a variety of good plain food will tend to keep the pullets in profit, any sudden change, such as from wheat to oats or barley, may cause a number to go into a "false" moult. A sudden change from old- to new-season wheat has been known to cause a whole flock of pullets to stop laying and go into a moult. When one has to start using the new-season wheat it is safer to make the change gradually—that is, by mixing in first one-quarter of the new with the old wheat, then half, and so on, until the full change has been made, say, in a week or ten days' time. As the pullets come into full lay, the amount of animal food may be gradually increased until up to 10 per cent. or even 12 per cent. is being fed during May, June, and July. It can then be gradually reduced until about 7 per cent. is fed during the spring months.

A regular supply of succulent green feed is necessary to keep the stock in the best of condition, but it is just as well not to give too much during the winter months. A good time to give the green feed is after the last feed at night.

Feather-pulling.

Inquiries have been made as to the cause and treatment of pullets pulling one another's feathers. This bad and annoying habit is often started in the spring amongst young stock, but at times birds of all kinds pick and eat their own feathers or those of other birds. Sometimes the habit is limited to only a few birds, but more often whole flocks are affected. Where this depraved habit once becomes well established it is very difficult to check. The trouble is more frequent where birds are kept on the intensive system, and especially if at all overcrowded.

Experience indicates that this is a deficiency trouble and that the habit is often started by a search for something lacking in the food. At times one bird may start the habit by plucking the young feathers from another bird's tail, and if blood is caused to flow other birds often greedily attack and eat the feathers, and even the flesh of the bird. The crowding of birds into small pens where they have nothing better to do often leads to the formation of the habit, or birds in order to get rid of insects will at times pluck their own feathers. As regards treatment, the first thing to do is to try to ascertain the cause and remove it. It is advisable to keep a close watch on the birds, and if one is noticed pulling another's feathers it should at once be separated from the rest. It is well to make sure that the birds and houses are free from insects. If possible give the stock a run out, and if circumstances are such that this cannot be done, encourage the stock to exercise by increasing the amount of litter. See that a regular supply of green feed is given, and increase the amount of animal food, but reduce the amount of fat-forming food. It is also well to add to the mash a teaspoonful of sulphur for each twenty-five birds, and dissolve in the water with which the mash is mixed a teaspoonful of Epsom salts to each twenty-five birds.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Removal of Supers.

INCLUDED in the autumn work which must not be neglected is removal of the supers, and this should be undertaken as soon as the extracting-combs are cleaned up by the bees. It is bad management to leave the bees more space than they can occupy. By removing the supers the space in the hive is restricted, and consequently it is much easier to make the bees snug and warm for winter. Where the strength of the colony permits this should be done, as nothing is to be gained by leaving on the supers. However, it may be impossible in the case of strong colonies to confine the bees to the brood-chambers, in which case the supers can be left on the hives until the spring. By that time most of the bees will be in one story, and the supers can then be removed.

A good plan to follow in getting the bees to clean up the combs is to insert a mat, in which a small hole has been cut, between the brood-chamber and the super. The bees, finding the combs partly cut off by the mat, lose little time in removing the surplus honey. At this operation the excluders should be removed from the hives and stored away until such time as they can be cleansed of burr combs. A little care is necessary in dealing with the excluders, so as not to bend the wires. They can be readily cleansed by plunging them into boiling water.

Winter Stores.

The losses attendant upon starvation are no less serious a menace to the beekeeper than disease. While disease is met with from time to time, each autumn brings the problem of wintering the bees, and, while the professional will prepare his colonies so as to guard against serious losses, the average beekeeper is apt to overlook the matters that make for success. There are factors such as shelter, watertight hives, vigorous young queens, &c., which all play a part in the wintering problem; but, above all, a supply of food sufficient to meet the colonies' wants must not be overlooked. The safe wintering of bees is a test of a beekeeper's capabilities, as he is called upon to gauge the amount of stores required to tide his bees over the period between the autumn flow and the appearance of the early nectar-secreting plants. Locality plays an important part, more especially where autumn flows are unknown and fine autumn weather prevails. In these districts the consumption of stores is greater, and a constant watch must be kept on the hives so as to determine the amount of food required to guard against loss, as breeding will be carried on until a later period in the season.

Various estimates have been given as to the amount of food required to winter the cluster, varying from 30 lb. to 40 lb., and experience has proved that, providing a colony is left with this amount, it not only winters well but builds up rapidly in the spring. In any case, it is by far the safest policy to leave an excess of food rather than run the risk of leaving the colony short and with barely enough to tide it over the dormant period. Where the amount of stores is less than 30 lb., the shortage can be made up quickly by the insertion of a few combs of honey. Calculating on the basis that a full comb contains 6 lb. of honey, it is easy to estimate the weight of honey in the hive. If, however, combs of honey are not available, feeding should be undertaken. This latter operation should not be delayed till the cold weather, but commenced early in the autumn.

For supplementing the stores, sugar syrup, fed in the proportion of two of sugar to one of water, is the best substitute for honey. Avoid using inferior qualities of sugar: none but the best white sugar should be fed. In feeding to augment the winter food-supply it is often necessary to give large quantities of syrup, and consequently large feeders must be adopted. The Miller and the division-board feeders are excellent for this purpose. The former enables about 10 lb. to 25 lb. of stores to be fed at one time. It is designed to be placed inside the super or upper story on top of the brood-frames, and has two compartments for syrup, the passage-way for the bees being in the centre through the bottom, directly over the cluster. The division-board feeder is popular, and enables about 5 pints of syrup to be fed. It hangs between the frames, and all that is necessary is to turn back the mat so that the opening in the top is exposed. The main advantage of this feeder is that food can be supplied without exposing the cluster and without the aid of smoke.

Shelter Essential.

As in the spring, a vital necessity at this time of the year is shelter for the hives. Brood-rearing must be encouraged if the bees are to go into winter quarters sufficiently strong to give good results the following season. If a shelter-hedge or fence has not been provided an excellent temporary breakwind can be erected with manuka-scrub. Shelter without too much shade is the life of an apiary, and on no account should large trees be utilized as a means for protecting the hives. The spaces between the trunks are productive of draughts, and the high branches exclude too much of the sunlight. A live hedge 8 ft. to 10 ft. high is the ideal shelter for an apiary.

Foul-brood.

The risk attendant on carrying over diseased bees is too great, as the trouble is more likely to be spread in the autumn and spring by robbing. In cases where weather conditions have prevented successful treatment, or in which disease is detected on making a final examination prior to putting the bees into winter quarters, it is advisable to remove all combs showing the slightest signs of disease. Where disease is detected in a bad form nothing will be gained by holding the colony over for treatment, and by far the safer plan is to destroy it.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

The Past Season.

HEAVY rain, accompanied by high winds during the summer season, is a severe test for horticultural crops. Fortunately such tests are rare, but when they do occur they are not soon forgotten. The season just past has been remarkable for more than one in most parts of the Dominion. The seared foliage and broken branches in many plantations in some parts of the country are evidence of the unusual severity of the storms. In spite of these experiences the season generally has been a good one in many gardens, including those where fruit, vegetables, and flowers are grown in commercial quantities. Crops sometimes have suffered, but not seriously, owing to adequate shelter, secure support for crops which require it, and good drainage being provided. The needs of this kind often vary rather widely, depending very much on the lay of the land and its elevation, as well as the reputation of the locality; but it is very noticeable that the more experienced growers take very little risk from damage from such storms: they lose no time in carrying out the necessary improvements in a very thorough manner. Under the circumstances, quite a few crops benefited considerably from the warm showers; such, for instance, as kidney-bean, marrow, and salad crops.

As is to be expected under the circumstances, crops seriously attacked by insect pests were rather rare, as even those insects which flourish under moist conditions suffer considerable loss in stormy wet weather. Virus diseases among tomato crops, which have levied a heavy toll during recent years, were this season present generally in insignificant proportions. The reason probably is that the thrips and other sucking insects which are the principal carriers of these diseases were well controlled and considerably reduced in numbers by the stormy conditions. The most conspicuous disease in that crop this season was "late blight," *Phytophthora infestans*, which is what one would expect under the humid conditions. Needless to say, where Bordeaux was thoroughly applied the loss from this cause usually was not significant.

Much of the land suitable for horticultural crops lies low and is more or less subject to flooding, or it is liable to be scoured by considerable quantities of water from steep country in the vicinity. To temporize with such circumstances frequently means poor crops and too often a total loss, when, on the other hand, adequate drainage would secure a succession of the good crops which such land should carry, and disaster from flooding would generally be very rare. Where it is necessary, a drainage scheme should be well thought out and carried out now in a thorough manner. Tile drains, drains made with a mole-plough or of manuka-scrub, and open drains, are all effective under certain conditions. The first study should be the successful work of the kind which has been done in the locality Wet land sometimes dries out and sets very hard, and in either of those extreme

conditions it is of little use; but when it is drained such conditions rarely or never occur, and the friable condition so essential for fertility is soon established.

In few parts of the country may horticultural crops be grown without shelter plantations and hedges. These sometimes fail because they are set at intervals that are too wide, and intersecting-hedges would put matters right. Less frequently failure is due to the lines of shelter-trees being too close and too high; the cropping-areas are then overshaded and there is sometimes insufficient air. This is usually one of the mistakes of early settlers, who planted vigorous species of pines for this purpose at short intervals in good land.

The planting-season extends from May to September inclusive, and during that period shelter plantations and hedges may be planted with good prospects of success if the land is well prepared and planting is done when the soil is sufficiently dry to be friable. Here, again, local experience should be carefully studied before coming to a decision with regard to the kinds of trees and shrubs to plant. It is generally best to select plants which, so far as possible, have the desired qualities natural to their habit. These qualities generally are in regard to height and spread; also a good furnishing of foliage to the base. If these can be obtained without the necessity of frequent trimming and topping, much labour is saved. Lombardy poplar interplanted with barberry or privet, &c., is a popular combination of the kind. Ultimate height without topping in this case depends on spacing and the quality of the soil, where it is inclined to run high the next parallel shelter may be lower than otherwise and at a greater distance. Lawson's cypress (*Cupressus Lawsoniana*) also has the qualities of moderate height and spread with a well-furnished base. It has also been interplanted with poplar with good results. Roman cypress (*Cupressus sempervirens stricta*) has similar qualities with even less spread. Other evergreen conifers that are somewhat similar, but have a greater height, are Redwood (*Sequoia sempervirens*), Douglas fir (*Pseudotsuga Douglasii*), *Cryptomeria elegans*, and *Cupressus torulosa* All of these are thickly clothed to the ground, and have a moderate spread. Under poor soil conditions *Pinus muricata* underplanted with *Elaeagnus japonica* is often most satisfactory in forming good close shelter; but where the soil is at all good they are, for this purpose, inclined to ramp. On land fair to good, and especially where exposed to salt winds, species of the native *Coprosma*, *Olearia*, and *Metrosideros* have good appearance, moderate height, are compact, and require little attention to make them effective shelter. Many of them are at their best when growing in exposed positions. These suggestions have in view chiefly a one-line shelter-belt with perhaps a hedge under-planted or interplanted.

Vegetable Crops.

The preparation of the land and the purchase of seeds and other supplies compels an early decision on such subjects as what is to be grown next season and where. Such questions are of the greatest importance in attaining the best results, especially when the cropping is done as a commercial enterprise, for then very often it is a question not only of what crop is likely to be in keen demand, but also at what season it must be produced to find a good market. Those who are accustomed to cater for markets are always impressed by the varied and changing demands, especially in the trade in plants and flowers. A close and sympathetic touch with the market is necessary to forecast correctly the demands of the future, and the success of many is due to not only producing big crops, but also securing good prices, by this means chiefly: production and profitable distribution must always be considered together in commercial cropping of this class. Personal preference must be entirely laid aside, and the market demand must be studied with detachment.

The land and climate also naturally vary from place to place, and each piece of land under cultivation has its limitations, but also its special possibilities and qualities. It may be frost-free or subject to low temperatures ; situated in a wet climate or a dry one ; consist of light land or heavy ; and so on. Each condition has its own special range of opportunities, and successful cropping, particularly when it is for commercial purposes, depends on one taking full advantage of them—not struggling against adverse conditions, but making the most of those conditions which are advantageous. For instance, one situated in a locality with low temperatures has but a poor chance of competing in the early-potato market (unless transport conditions are outstandingly to his advantage) with those growers in frost-free districts. On the other hand, the latter has no chance of competing with growers in the colder and drier districts in the production of main-crop potatoes and potatoes for seed.

Then, again, heavy land recently broken in—drained recently but not having had time to acquire all the advantages of that operation—may be so unsuitable for most kinds of crops that it may have to be sown down in grass and grazed for a number of years before it can with advantage be broken up for annual cropping. Or newly ploughed grassland that is heavy may be insufficiently friable for fine seeds during the first season, and it is one of the reasons why potatoes are so often planted on land of that kind. Not that the land in its present condition is very suitable for that crop, but it is one of the few which makes some little return while the process of improvement of the soil by periodical cultivation is taking place.

On land where horticultural crops have been grown for some time the economy and advantages of crop rotation are generally well understood ; but, as with many good precepts, it is sometimes difficult to practise crop rotation as one would like. For instance, the limitations of profitable market-demand may reduce the crops to such a small variety and number that a suitable rotation is difficult to arrange. Then, one has to break new ground at intervals and sow down and graze the cropped land for a period—an excellent method—or one has to be satisfied with one cash-crop per annum and follow it up with a green crop for ploughing under, a method which has rather a limited application. On the other hand, that portion of the domestic home-garden which is devoted to annual vegetable crops may be so small that a rotation, in the ordinary way, cannot well be arranged ; in which case by severely limiting the variety of crops grown each season a total change of crops may be made from year to year—a method which will establish a satisfactory rotation of cropping with all of its advantages, simplify the management, and be a constant source of renewed interest. When the position and kind of crop to be grown have been decided, the manuring and cultivation of the land can be carried out in an appropriate manner.

Potato-seed for spring planting should now be sprouted by placing it in single layers in trays and stacking them in a place which is light, free from frost, and where they will also be free from the attack of the potato-moth.

Small and Sundry Fruits.

Established plantations of bush-fruits may now be given a dressing of well-cured farm manure, which should then be ploughed under, taking care not to go to a depth exceeding 6 in. On heavy, moist loam alternate years may be sufficiently frequent for this dressing ; the other year at this season a liberal dressing of suitable fertilizers may take its place. On light land an annual application of manures will probably be needed in addition to fertilizers. Where farm manure is scarce it is often advisable to apply a liberal dressing of phosphates and sow down the alleys with a green crop as soon as harvesting is completed.

The Homestead Garden.

Whether the garden is in the process of being newly made or is long-established, the planting-season is a period of the greatest importance to successful management. The term specially applies to the transplantation of hardwood plants, which may not generally be removed at other seasons without risk unless they are grown in pots. Early-autumn planting is generally best; where there is some risk of somewhat tender plants being exposed to hard conditions during the winter, spring planting will be advisable. Where winter planting is done, fine weather and a friable soil are necessary conditions when working on heavy land. Planting during a frost should not be done.

Position and arrangement are of the greatest importance, but should be decided at leisure before receiving the plants. At planting-time important precautions are to trim neatly straggling and broken roots, set the plants to the same depth as they previously grew, thoroughly firm the soil round the roots by tramping, then carefully study the plant and perform such pruning with sharp, well-set secateurs as may be necessary. Some authorities—very good ones, too—recommend for most hardwood plants that this pruning be done so late as the following winter after planting, —that is, after twelve months—but for newly planted subjects of this class, generally, such pruning as may be required would probably be best done in the spring, although pruning immediately after planting is often quite satisfactory.

A young plant usually has too many branches or not enough Too many, if allowed to remain, quickly set up a congested condition which retards growth. Light and air for all parts of the plant are a necessity as fundamental as the soil in which it is set and the water it receives. Strong leading growth then, in excess of what is required, should be removed completely, cutting it away close up to the branch from which it originates. In many instances, as in the case of a rose-bush, three primary branches are sufficient; in the case of conifers which are grown as a pyramid with a central axis, more than one central leading growth is very disfiguring and others should be removed at once. Similar treatment is given to a climber where one or two leading growths are desired—the others are eliminated completely. This does not mean that every growth should be removed; light laterals are allowed to remain; it is the stronger leading growth only which is thinned, thus concentrating growth and vigour into selected branches which will form the base of the main framework of the future bush or tree. The leading growth should then be shortened back to a point just beyond a bud pointing in a desired direction for future growth. In the case where the young plant is of straggling growth, and it is desired to make it stool or branch out, the method is to cut away the leading growth at a height just above the point where branching is desired. Japanese cherries and that popular winter-flowering plant *Lasiandra macrantha* (*Tibouchina semidecandra*) are very commonly among those which usually require this treatment to secure a good display, which is markedly superior to that on trees untrained.

Many trees and shrubs require little pruning after they have become permanently established, but all require the attention above described in order to obtain quick development on the right lines.

—*W. C. Hyde, Horticulturist, Wellington.*

Transmission of Pathological Specimens by Post.—The restriction on the sending of specimens by parcel-post mentioned in the statement on page 175 of the March, 1936, *Journal* has been removed.

Lemon-curing for small Growers.—In the method of lemon-curing described on page 105 of the February, 1936, issue of this *Journal*, the use of sawdust is recommended. This advice needs to be qualified by the statement that sawdust derived from pines or from *Cupressus macrocarpa*, because of the possibility of its tainting the fruit, should not be used.—*W. K. Dallas.*

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

BEE-KEEPING.

Apiarist, Waipawa :—

1. What would be a fair division of the profits between the owner of the land on which the bees are kept and the apiarist—
   (*a*) When the landowner supplies the bees (black), and the apiarist the hives and all accessories, and looks after them in his own time and at his own expense ?
   (*b*) When the landowner merely gives permission to run bees on the property but supplies no part of the outfit ?
2. In certain books it is stated that gorse, broom, hawthorn, and manuka are good nectar-yielding plants. In this district, though there is abundance of all these, the bees are never seen on their flowers, except occasionally an odd one on gorse, collecting, probably, pollen rather than nectar. In the case of manuka, a hive bee is rarely seen on it, but the native bee frequently. Can you account for this ?
3. Is subterranean clover of any value for bees ?
4. Is the honey from cabbage-trees of good or inferior quality ?
5. Occasionally the honey in this district has a slightly bitter flavour. From what source would this probably be gathered ?
6. During the prevalence of the bad weather this spring I noticed the bees "balling" a young queen at the entrance to a hive, and on another occasion found one dead at the hive entrance. What would be the reason for this ?

The Horticulture Division :—

1. (*a*) A matter of arrangement between the parties concerned.
   (*b*) A nominal rental is usually charged. In many cases farmers grant the use of sites to beekeepers conditionally on being supplied with honey for the household use
2. Gorse is not of value as a honey plant. It is the main supply of pollen in most districts. Broom supplies both pollen and nectar. Hawthorn is said to yield well in some localities, in others bees are never seen working the blossoms. Manuka : Heavy yields of honey are taken from this source In Southland the late James Allan, who had considerable experience in that area with bees, reported that he had never seen a bee on the manuka-flowers. However, in the northern districts it yields honey abundantly
3. Subterranean clover is valuable for bees.
4. Not known. The honey from this source is usually mixed with honey from other plants.
5. Probable source of bitter honey could no doubt be traced if sample of honey were made available.
6. The "balling" of your queens was probably due to the presence of more than one queen in the hive.

BORER IN TIMBER.

L. M. P., Napier :—

An old shearing-shed which is very badly infested with borer is to be replaced immediately by a new one in the same place. Could you tell me the best way to destroy the borer on the site ?

The State Forest Service :—

All timber infested with the borer in the vicinity of the site on which the new shed is to be erected should be destroyed, and care should be taken that no small pieces of wood or infested piles are left in place. If all borer-infested timber is destroyed the site itself will need no further attention.

DOSING OF SHEEP FOR CONTROL OF PARASITES.

C. S. M. HOPKIRK, Veterinary Laboratory, Department of Agriculture, Wallaceville.

IN the *Journal* for February, 1936, a paragraph was inserted warning farmers that there was every indication that the weather and food conditions of this abnormal season would prove beneficial for the growth of internal parasites, so bringing about severe losses in hoggets. Although there is not as much danger as was at first feared, yet lambs have not done well, and since weaning many have been backward and remain fit subjects for parasitic damage.

It was stated that a pound each of bluestone and Black Leaf 40 should be used in 5 gallons of water and that the dose should be ½ oz. for lambs and 1 oz. for young sheep.

Black Leaf 40 is an American trade-name for nicotine sulphate containing 40 per cent. of the alkaloid nicotine. There are on the market several preparations of nicotine sulphate (40 per cent.) labelled under various names, and there is no reason to believe that one is more efficient than another. Therefore, any brand of nicotine sulphate (40 per cent.) may be used.

In making further inquiries into the amount of nicotine sulphate going to a pound it was found to vary: 14 oz. to the pound was found common to one brand. On that account the prescription must now be altered to give ounces and not the bulk weight of one pound.

In respect to dosage, in other countries there are two distinct quantities in use, giving about the same total amounts of bluestone and nicotine. In one prescription ⅓ oz. of each is added to the pint of water and the dose is then about ⅓ oz. (10 c.c.) for lambs and a little more for hoggets—*i.e.*, ½ oz. This dosage is given by drenching-gun or by syringe. The other type of prescription gives the dose as 1 oz. suitable by its bulk for the usual New Zealand method of drenching with a measure This latter prescription is made up of 1 oz. of each ingredient to the pint of water.

Starving is unnecessary as the copper sulphate has a chemical action which opens up the œsophageal groove to the fourth stomach, the drench going straight there instead of into the rumen first as with most materials given to ruminating animals. It is desirable, however, to keep the sheep away from water for a couple of hours after drenching.

The prescription, then, for New Zealand use may be given as follows: nicotine sulphate (40 per cent.), 16 fluid ounces; copper sulphate, 16 oz.; water, 5 gallons. Dose: One ounce for weaned lambs and 1½ oz. for two-tooths. If lambs are drenched before weaning ½ oz. may be given. The drench should be repeated at not more than three-weeks intervals throughout the season.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 27th February, 1936, to 26th March, 1936, include the following of agricultural interest:—

No. 73017 and No. 73510: Concrete post; H. W. and L. A. James. No. 73458: Soldering-iron; G. R McCarthy. No. 73842: Harrow; A. S. Bevin. No. 73904: Lawn-mower attachment; S. Lecky. No. 73930: Harrow; T. G. Aston and H. C. Frampton. No. 74020: Milk-can ventilating; F. Fitzgerald. No. 74186: Teat-cup; Gordon Vacuum Break Milkers, Ltd. No. 74324: Cognate with No 74020 above. No. 74957: Fencing-post; C. A. Mason. No. 75164: Fruit-preserving; W. G. Hampson. No. 75346: Agricultural implement; J. A. Fishleigh. No. 75405: Teat-cup; C. E. Ellison. No 73364: Meat-handling; R. Robinson. No. 73647: Veterinary remedy; H. MacK. Salmond. No. 74094: Milking-machine; H. H. Johnson. No. 74223: Insecticidal oil composition; California Spray-chemical Corp. No. 74300: Teat-cup claw; A. H. Atchley. No. 75012: Flour-treatment; O. H. Joos. No. 75225: Horse-collar; D. G. Robinson. No. 75351: Distribution of vitamins in milk; Nestle and Anglo-Swiss Condensed Milk Co.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

WEATHER RECORDS: MARCH, 1936.

Dominion Meteorological Office.

NOTES FOR MARCH.

THOUGH not nearly so much so as February, March was a wet month in most districts, and there are few in which the soil is really dry. Feed is abundant and stock are reported to be in good condition. Pastures are, however, rank and soft, and lambs still fail to fatten well. The milk-yield appears on the whole to be well maintained, though in Taranaki cold winds had a deleterious effect. Little progress has been made with the harvesting of the wheat crop, much of which is now in the stack. The situation regarding root crops varies considerably from district to district, growth being poor and pests numerous in some, while in others the reports are favourable. Supplies of feed for the winter, however, seem fairly well assured.

Rainfall.—Rainfall was again very heavy in the northern portion of the Auckland Peninsula. It was much above normal also in the Bay of Plenty, East Coast, south central regions, and the South Taranaki Bight. Elsewhere in the North Island it was below normal. In the South Island conditions were variable in western districts and about the main ranges generally, but elsewhere the month was a very wet one. Large areas of Canterbury had three times the average fall.

Temperature.—Temperatures were everywhere below normal. In the far North the departures were small, but they increased to the southward and were greater on the east coast than on the west. For the country as a whole, it was probably the coldest March ever experienced. Frosts were not particularly numerous or severe.

Sunshine.—There was much less sunshine than usual in most of the North Island, though the Bay of Plenty and Wellington fared well enough. In the South Island all reports indicate more than the normal amount, and in most cases the excess was considerable.

Storm Systems.—On the night of the 2nd to the 3rd a depression, which had been shallow when it crossed the country, deepened very much while to the eastward. In consequence, southerly gales blew and heavy rain fell over the South Island and across Cook Strait to the southern portion of the North Island.

Following this, fine weather ruled for several days. On the night of the 6th to the 7th, however, a depression moved from the north to the vicinity of East Cape, and, though shallow, it caused very heavy rain between Hawke's Bay and East Cape.

Following the passage of an innocuous depression on the 7th, pressure again fell rapidly to the east of New Zealand on the 8th and continued low until the 11th. Gales from between west and south were experienced at many places, and heavy rain was almost general. There were heavy snowfalls on the high levels.

Heavy rain again fell over the South Island in connection with a depression which moved on to the Dominion during the 20th and 21st.

On the 25th a deep cyclone, which had first appeared off the Queensland coast on the 18th passed Norfolk Island on the westward side and on the 26th was centred near Cape Maria van Diemen. Moving in a south-easterly direction, it was centred off East Cape on the morning of the 27th, and soon moved away. It was responsible for very severe gales and remarkably high tides from Auckland northwards, and much damage was done. Heavy rain was recorded over most of the North Island.

From the 28th until the end of the month, a westerly depression, followed by a series of secondaries, caused a second series of westerly or south-westerly gales, which were severe in many places.

RAINFALLS FOR MARCH, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average March Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
North Island.						
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	2·08	8	0·79	3·10	20·27	10·54
Russell	7·76	6	5·50	3·28	45·35	9·52
Whangarei	5·90	17	3·24	4·45	29·09	12·25
Auckland	2·48	12	0·56	3·27	18·64	9·81
Hamilton	3·14	12	0·87	3·76	19·14	10·24
Rotorua	4·03	12	1·22	3·48	27·02	11·44
Kawhia	2·96	8	0·91	4·21	16·12	9·83
New Plymouth ..	2·06	13	0·92	3·68	16·79	11·80
Riversdale, Inglewood ..	4·80	12	2·69	7·05	28·93	20·58
Whangamomona ..	3·06	4	2·25	4·98	18·47	14·45
Hawera	2·24	9	0·64	3·01	14·34	8·92
Tairua	3·11	12	0·90	5·21	21·83	13·55
Tauranga	6·17	14	3·24	3·92	24·07	11·73
Maraehako Station, Opotiki	5·37	9	3·96	3·96	24·44	11·69
Gisborne	5·43	16	2·53	4·42	20·65	10·60
Taupo	1·92	8	0·58	3·14	19·35	9·25
Napier	6·15	14	2·13	2·66	23·21	7·62
Hastings	5·89	14	2·45	2·76	21·91	6·94
Whakarara Station ..	4·35	8	1·10	..	26·09	..
Taihape	2·67	15	0·87	2·60	18·17	8·19
Masterton	..	..	..	2·75	..	8·09
Patea	3·72	12	1·16	3·35	15·72	9·34
Wanganui	2·80	10	1·11	2·47	15·02	7·72
Foxton	2·33	7	1·05	1·98	14·11	6·19
Wellington	4·64	13	1·38	3·20	17·88	8·84
South Island.						
Westport	6·50	14	2·09	7·50	13·44	21·05
Greymouth	9·39	14	3·10	8·80	18·58	24·18
Hokitika	9·53	15	3·09	9·51	17·76	26·83
Ross	12·80	12	4·45	10·73	22·72	32·03
Arthurs Pass	11·52	12	3·46	13·19	20·82	37·21
Okuru, South Westland	10·44	6	3·50	14·15	35·01	36·40
Collingwood	3·22	10	1·88	5·81	20·35	17·68
Nelson	1·45	6	0·60	2·92	8·21	8·45
Spring Creek, Blenheim	1·88	7	0·92	1·98	9·80	6·38
Seddon	1·75	9	0·52	2·00	10·27	5·69
Hanmer Springs ..	4·94	15	2·02	3·26	22·52	10·47
Highfield, Waiau ..	2·87	9	1·18	2·84	18·45	8·42
Gore Bay	4·77	11	2·40	2·13	15·61	7·39
Christchurch	6·07	13	2·27	1·84	14·25	5·73
Timaru	4·38	8	1·35	2·16	14·32	6·34
Lambrook Station, Fairlie	..	..	..	2·34	..	6·58
Benmore Station, Clearburn	2·12	8	1·05	2·41	4·76	6·80
Oamaru	3·20	10	1·51	1·78	12·56	5·61
Queenstown	3·24	12	0·78	2·62	7·20	7·46
Clyde	1·71	8	0·37	1·49	3·32	4·40
Dunedin	6·12	15	2·32	2·90	16·21	9·02
Wendon	4·43	17	0·78	2·74	8·60	8·20
Balclutha	4·76	13	1·34	2·31	7·42	6·61
Invercargill	4·86	21	1·10	3·89	11·30	11·07
Puysegur Point ..	7·69	21	1·74	7·97	19·43	21·33
Half-moon Bay ..	4·83	20	0·59	5·37	9·31	14·27

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TOMATO-SEEDLING DAMPING-OFF.

I. CONTROL BY SOIL-TREATMENT.

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DAMPING-OFF has for many years been a troublesome disease of tomato-seedlings throughout New Zealand, being first recorded in the Dominion by Taylor* in 1924. It is of world-wide distribution, occurring in both temperate and tropical regions.

Damping-off is caused by fungi which are carried over from season to season in the soil, so that control of the disease may be secured only by soil-treatments. The disease is a serious problem to growers who have not the facilities for steam disinfection, a process which experience has shown gives an effective control. For these growers certain chemical treatments are available. The present investigations have been carried out to determine the relative values under New Zealand conditions of the more commonly recommended treatments and to test certain new compounds.

SYMPTOMS

Tomato-seedlings are susceptible to attack by damping-off fungi from the time the seeds germinate until some time after the plants are pricked out. When infection is severe a large number of seedlings may be attacked and killed before they reach the surface of the soil. This type of attack, known as pre-emergent damping-off, may be confused with poor germination of the seed. Frequently, however, the seedlings become infected after they emerge. In such cases the stems become constricted at or just above soil-level, and the seedlings fall over (Fig. 1). This type of infection is known as post-emergent damping-off. Less commonly, pricked-out plants several inches tall are attacked (Fig. 2).

CAUSE.

In other countries it has been found that seedling damping-off may be caused by several fungi. To ascertain the fungus responsible in New Zealand, isolations were made from specimens of infected tomato-seedlings obtained from various districts. Cultures of *Pythium ultimum* Trow.† or *Corticium vagum* Berk. *et* Curt.‡, or both, were isolated, the former being more prevalent.

* TAYLOR, W. H. (1924): *N.Z. Jour. of Agric.*, Vol 29, pp 40-43

† Cultures of this fungus were kindly identified by Mr. S F Ashby, Director of the Imperial Mycological Institute.

‡ This strain was found to be identical with that attacking potatoes.

Experimental Method for Soil-treatments.

All experiments were carried out in the glasshouse, using a soil mixture of clay loam and silt in seed-boxes 18 in. by 12 in. and 3 in. in depth. This soil, untreated in some cases and steam-disinfected in others, was inoculated seven to ten days prior to treatment, with cultures of either *P. ultimum* or *C. vagum* grown on potato dextrose agar.

There were two types of treatments: (1) The disinfectants were applied to the soil in the form of solutions; (2) they were applied as dusts.

(1) The solutions were applied at the rate of ½ gallon per box, a quantity more than sufficient to saturate the soil, the excess liquid being allowed to drain off. In order to maintain comparable soil

FIG 1. TOMATO-SEEDLING DAMPING-OFF.
Portion of a box of seedlings showing damping-off, caused by *Pythium ultimum*.

conditions throughout, ½ gallon of sterile water was added to all boxes not receiving treatment with chemical solutions. The treatments were carried out two to three weeks prior to sowing the seed, and, to facilitate drying, the soil was turned over at least twice during this period.

(2) The dusts were thoroughly mixed into the top half of the soil immediately before sowing.

In all experiments tomato-seed was sown in all boxes at the same time, at the rate of $\frac{1}{16}$ oz. per box. After damping-off appeared, counts of the number of infected plants were taken daily. Final counts of the number of plants left in the boxes were taken approximately five weeks after sowing, by which time they had advanced past the damping-off stage.

The following treatments were used :—

(1) *Steam Disinfection.*—Soil was placed in shallow trays in a bin and steamed for twenty minutes at a boiler pressure of 80 lb.

(2) *Formalin Solutions.* — Commercial formalin is a 40-per-cent. solution of formaldehyde. The solutions were used at concentrations of 1·25 per cent., 1 per cent., and 0·83 per cent. of formalin.

(3) *Acidulated Mercuric Chloride Solutions.*—These contained 2·5 parts by weight of concentrated hydrochloric acid solution to each

FIG. 2. TOMATO-SEEDLING DAMPING-OFF.

Plants which have become infected after pricking out. Healthy plant on right.

part of mercuric chloride. Thus a 0·1-per-cent. solution of mercuric chloride would contain 0·25 per cent. hydrochloric acid. Concentrations of 0·1 per cent. and 0·067 per cent. of acidulated mercuric chloride were employed.

(4) *Mercurous Chloride.*—This salt is almost insoluble in water, and was applied, therefore, in suspension. It was used at a concentration of 0·067 per cent.

(5) *Acetic Acid.*—This was applied as a 1-per-cent. solution.

(6) *Shirlan W.S.*—This is the trade name for sodium salicylanilide, a compound which has recently come into prominence as a fungicide. It was applied as a 0·25-per-cent. solution.

(7) *Potassium Permanganate.*—This was used as a 1-per-cent. solution.

(8) *Cheshunt Compound.*—This name is applied to a mixture of two parts by weight of copper sulphate and eleven parts of fresh ammonium carbonate. It was used as a 0·3-per-cent. solution.

(9) *Uspulun and Aretan.*—These are trade names applied to organic mercury compounds. The former was used at concentrations of 0·25 per cent. and 0·5 per cent., and the latter at 0·5 per cent.

(10) *Boiling Water.*—This was applied at the rate of 1 and 2 gallons per box of soil.

(11) *Formalin Dust.*—This consisted of a mixture of 15 parts of commercial formalin and 85 parts hydrated lime. It was applied at the rate of 1½ oz. per box.

(12) *Brassisan Dust.*—"Brassisan" is the trade name for an organic mercury compound. It was applied as a dust at the rate of ⅛ oz. per box.

EXPERIMENTAL RESULTS.

Experiment I: Control of P. ultimum and C. vagum

This, a preliminary experiment, was carried out in the spring of 1934, using farm soil which was not steam-disinfected before inoculating with cultures of the fungi. The treatments employed were as follows: Steam disinfection; formalin, 1·25 per cent. solution; potassium permanganate, 1 per cent. solution; Cheshunt compound, 0·3 per cent. solution; acidulated mercuric chloride, 0·1 per cent. solution; "Uspulun," 0·25 per cent. solution, and formalin dust, 1½ oz. per box. In addition, uninoculated untreated and inoculated untreated soils were included in the experiment. All boxes, two for each treatment, were sown with tomato-seed (variety Kondine) on 19th August, 1934. Unfortunately, the germination of this line of seed was poor, giving only 70 per cent. in ten days.

(*a*) Results on control of *P. ultimum*: The germination was good in the soil treated with steam and formalin, fair with Uspulun and formalin dust, and poor with potassium permanganate, Cheshunt Compound, and in the inoculated and uninoculated untreated boxes. In the formalin treatment the germination was slightly delayed, while the acidulated mercuric chloride caused severe injury to the seed. Damping-off occurred in all boxes except those treated with steam and formalin solution. Partial control was obtained with Uspulun and formalin dust, but the other treatments gave no control.

(*b*) Results on control of *C. vagum:* As in the above, complete control of damping-off was obtained only in the steam and formalin treated soils. Isolations from infected plants in the uninoculated untreated soil yielded cultures of *P. ultimum*, hence from the treatments other than steam and formalin, the results, in relation to the control of *C. vagum*, were confused by the presence of *Pythium*.

Experiment II: Control of P. ultimum.

The soil in this series was steam-treated before adding cultures of *Pythium*, in order to destroy other fungi already present. All boxes were sown on 25th October, 1934, with the variety Somner's Early Longkeeper. This line of seed gave a germination test of 91 per cent. in ten days.

Table 1.—Results of Experiment II Treatments applied to Steam-disinfected Soil inoculated with Pythium ultimum.

Treatment.	Number of Plants emerged	Percentage of Plants damped-off.*		Average per Cent. Plants damped-off.
		Pre-emergent	Post-emergent.	
Steam disinfection	Box A = 603	0	0	0
	Box B = 592	0	0	0
Formalin, 1·25 per cent solution	Box A = 568	0	0	0
	Box B = 615	0	0	0
Formalin, 0·83 per cent. solution	Box A = 283	52	17	76
	Box B = 247	58	25	..
Formalin dust, 1½ oz per box	Box A = 378	36	7	31·5
	Box B = 506	14	4	..
Boiling water, 1 gallon	Box A = 51	91	5	96
Boiling water, 2 gallons	Box A = 240	40	26	66
Acidulated mercuric chloride, 0·067 per cent solution	Box A = 23	Seed injury†	3	..
Uninoculated, untreated	Box A = 589	0	0	0
	Box B = 571	0	0	..
Inoculated, untreated	Box A = 11	98	1	99·5
	Box B = 5	99	1	..

* The total number of plants which germinated in the steam-sterilized soils were averaged and this figure taken as the average germination per box. All percentages were based on this average figure, pre-emergent damping-off being obtained by the difference between this figure and the number of healthy plants plus the number which showed post-emergent damping-off.

† The term "seed injury" in this and the following tables is applied to those treatments which depressed germination. In such cases it was not possible to calculate the percentage of pre-emergent damping-off.

Experiment III: Control of P. ultimum and C. vagum.

In this experiment damping-off fungi were added to both steam-disinfected and untreated soils. All boxes were sown on 14th June, 1935, with seed of the variety Sutton's Best of All. This seed had been saved from the current season's crop and gave a germination test of 99 per cent. in ten days.

Table II.—Results of Experiment III: Treatments applied to both Steam-disinfected and Untreated Soil inoculated with Pythium ultimum.

Treatment.	Number of Plants emerged.	Percentage of Plants damped-off.		Average per Cent. Plants damped-off.
		Pre-emergent.	Post-emergent.	
Steam-disinfected Soil.				
Steam disinfection ..	Box A=506	0	0	0
	Box B=532	0	0	
Formalin, 1·25 per cent. solution	Box A=526	0	0	0
	Box B=502	0	0	
Formalin, 1 per cent. solution	Box A=520	0	0	0
	Box B=416	0	0	
Formalin, 0·83 per cent. solution	Box A=512	0	0	0
Acidulated mercuric chloride, 0·1 per cent. solution	Box A = 4	Seed injury	0	..
Acidulated mercuric chloride, 0·067 per cent. solution	Box A=128	Seed injury	2	..
	Box B=192	Seed injury	2	
Mercurous chloride 0·067 per cent. suspension	Box A=215	Seed injury	21	..
	Box B=335	Seed injury	18	
Acetic acid, 1 per cent. solution	Box A=483	7	6	10
	Box B=496	5	2	
Uninoculated, untreated	Box A=504	0	0	0
Inoculated, untreated	Box A=211	59	35	82
	Box B=370	29	41	
Untreated Soil				
Formalin, 1·25 per cent. solution	Box A=513	0	0	0
	Box B=537	0	0	
Formalin, 0·83 per cent. solution	Box A=534	0	0	0
	Box B=530	0	0	
Acidulated mercuric chloride, 0·067 per cent. solution	Box A = 83	Seed injury	0	..
	Box B = 33	Seed injury	0	
Inoculated, untreated	Box A=323	38	34	72
	Box B=347	33	39	
Uninoculated, untreated	Box A=312	40	29	71·5
	Box B=292	43	31	

Table III.—Results of Experiment III: Treatments applied to both Steam-disinfected and Untreated Soil inoculated with Corticium vagum

Treatment.	Number of Plants emerged.	Percentage of Plants damped-off.		Average per Cent. Plants damped-off.
		Pre-emergent.	Post-emergent.	
Steam-disinfected Soil.				
Steam disinfection	Box A=506	0	0	0
	Box B=532	0	0	
Formalin, 1·25 per cent. solution	Box A=518	0	0	0
	Box B=511	0	0	
Formalin, 1 per cent. solution	Box A=522	0	0	0
	Box B=529	0	0	
Formalin, 0·83 per cent. solution	Box A=463	11	2	13
Acidulated mercuric chloride, 0·1 per cent. solution	Box A = 6	Seed injury	0	0

Table III—continued.

Treatment.	Number of Plants emerged.	Percentage of Plants damped-off. Pre-emergent.	Percentage of Plants damped-off. Post-emergent.	Average per Cent. Plants damped-off.
Steam-disinfected Soil—continued.				
Acidulated mercuric chloride, 0·067 per cent. solution	Box A=418	Seed injury	0	..
	Box B=329	Seed injury	0	
Mercurous chloride, 0·067 per cent. suspension	Box A=369	Seed injury	0	..
	Box B=387	Seed injury	0	
Acetic acid, 1 per cent. solution	Box A=518	0·4	3	4·7
	Box B=514	1·0	5	
Uninoculated, untreated	Box A=504	0	0	0
Inoculated, untreated	Box A=460	12	15	33
	Box B=487	6	33	
Untreated Soil.				
Formalin, 1·25 per cent. solution	Box A=540	0	0	0
	Box B=541	0	0	
Formalin, 0·83 per cent. solution	Box A=502	0	0	0
	Box B=502	0	0	
Acidulated mercuric chloride, 0·067 per cent. solution	Box A= 46	Seed injury	0	0
	Box B= 55	Seed injury	0	
Inoculated, untreated	Box A=254	51	25	79
	Box B=303	42	40	
Uninoculated, untreated	Box A=312	40	29	71·5
	Box B=292	43	31	

Experiment IV: Control of P. ultimum.

Soil treatments were carried out with farm soil which was not steam-treated prior to the addition of cultures of the fungus. All boxes were sown on 5th September, 1935, with the same line of seed as that used in Experiment III.

Table IV.—Results of Experiment IV: Treatments applied to Untreated Soil inoculated with Pythium ultimum.

Treatment.	Number of Plants emerged.	Percentage of Plants damped-off. Pre-emergent.	Percentage of Plants damped-off. Post-emergent.	Average per Cent. Plants damped-off.
Steam disinfection ..	Box A=469	0	0	0
	Box B=463	0	0	
Formalin, 1·25 per cent. solution	Box A=475	0	0	0
	Box B=498	0	0	
Shirlan, W. S., 0·25 per cent. solution	Box A=359	25	7	46
	Box B=286	40	20	
Uspulun, 0·5 per cent. solution	Box A=201	Seed injury	2	..
	Box B=127	Seed injury	1	
Aretan, 0·5 per cent. solution	Box A=137	Seed injury	4	..
	Box B=232	Seed injury	11	
Brassisan, ⅛ oz. per box	Box A=247	40	13	55
	Box B=259	38	19	
Inoculated, untreated	Box A=269	36	16	54
	Box B=272	35	21	
Uninoculated, untreated	Box A=350	27	21	53
	Box B=344	27	30	

DISCUSSION OF RESULTS.

In general it was found that damping-off became more severe in soil which had been steam-disinfected before being inoculated with the damping-off fungi (Fig. 3). Also it would appear from the effect of acidulated mercuric chloride on *Pythium* (Experiment III, Table II), and the effect of formalin 0·83 per cent. on *Corticium* (Experiment III, Table III), that damping-off was more easily controlled in untreated soil than in steam-disinfected soil.

(1) *Steam Disinfection.*

Complete control of damping-off was obtained in all cases where this process was adopted. No injurious effect on germination was observed (Figs. 3 and 4).

(2) *Formalin.*

(*a*) 1·25 per Cent. Solution: This concentration gave complete control of both *Pythium* and *Corticium* (Figs. 4 and 5). In Experiment I this treatment caused slight delay in germination of the seed. This was attributed to the fact that insufficient time had elapsed between treating and sowing, and thus all the formaldehyde had not evaporated from the soil.

(*b*) 1 per Cent. Solution: Used only in Experiment III, this concentration gave results comparable with the 1·25-per-cent. solution for the control of both fungi. Further tests with this concentration are necessary before it can be recommended.

(*c*) 0·83 per Cent. Solution: In Experiment II this concentration failed to control *Pythium* (Table I, Fig. 4). In Experiment III it appeared to control *Pythium*, but failed to combat *Corticium* growing in steam-disinfected soil (Tables II and III). This concentration cannot be relied upon to give control of either organisms.

(*d*) Formalin Dust: This product was used to combat *Pythium* in Experiments I and II. Although it reduced the amount of disease in each case, effective control was not secured (Table I, Fig. 5). Formalin dust cannot, therefore, be recommended.

(3) *Acidulated Mercuric Chloride.*

(*a*) 0·1 per Cent. Solution: At this concentration it caused severe injury to the seed completely inhibiting germination in Experiment I and reducing it to 1 per cent. in Experiment III.

(*b*) 0·067 per Cent. Solution: This concentration was used in Experiments II and III, resulting in injury to the seed in both instances. In Experiment II (*Pythium*) only 4 per cent. of the seed germinated, and of these a number damped-off (Table I). In Experiment III the germination was somewhat better, ranging from 6 per cent. in one box to 80 per cent. in another. Although under the conditions of the experiment it appeared to give complete control of *Corticium* and *Pythium* in soil not steam-treated, it failed to control *Pythium* in steam-disinfected soil (Tables II and III).

From these results it is evident that acidulated mercuric chloride solutions, even at concentrations which cause severe injury to the seed, do not give economic control of damping-off due to *P. ultimum*.

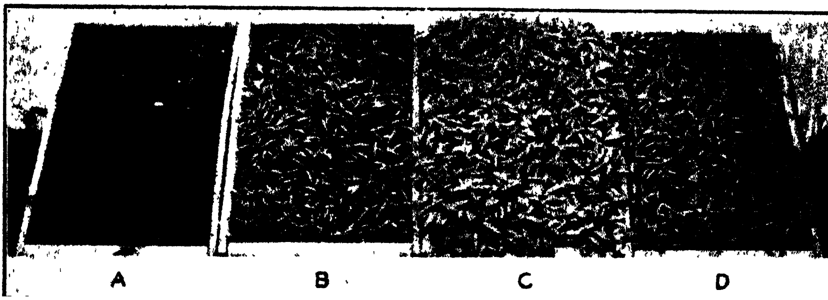

FIG. 3. EFFECT OF SOIL TREATMENTS ON TOMATO-SEEDLING DAMPING-OFF.

A—Steam-disinfected soil inoculated with *Pythium ultimum*. B—Untreated soil inoculated with *P ultimum*. C—Steam-disinfected soil inoculated with *P. ultimum* and then again steam-disinfected D Steam-disinfected soil inoculated with *P. ultimum* and then treated with a 1-per-cent solution of acetic acid

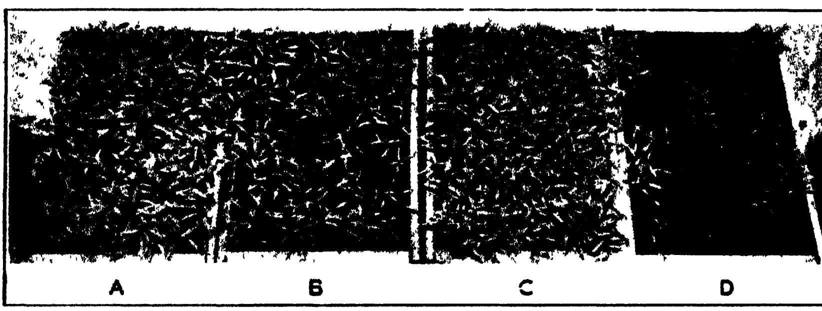

FIG 4 EFFECT OF SOIL TREATMENTS ON TOMATO SEEDLING DAMPING-OFF.

All four boxes contained steam-disinfected soil which had been inoculated with *Pythium ultimum*.

The treatments applied to this soil were as follows: A—Steam disinfection; B—Mercurous chloride, 0·067 per cent. suspension, C—Formalin, 1·25 per cent. solution; D—Formalin, 0·83 per cent. solution

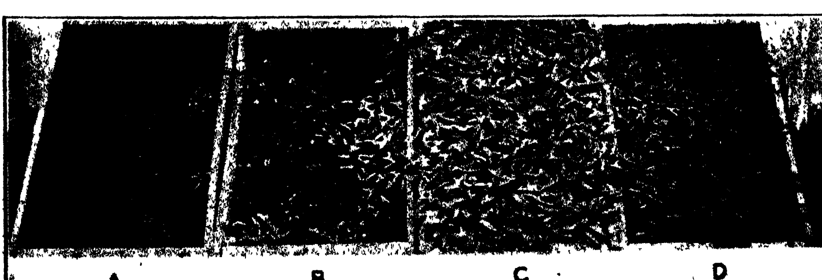

FIG. 5. EFFECT OF SOIL TREATMENTS ON TOMATO-SEEDLING DAMPING-OFF.

All four boxes contained steam-disinfected soil which had been inoculated with *Pythium ultimum*.

The treatments applied were as follows: A—Boiling water, 1 gallon; B—Boiling water, 2 gallons; C—Formalin, 1·25 per cent. solution; D—Formalin dust.

(4) *Mercurous Chloride, 0·067 per Cent. Suspension.*

This treatment was used only in Experiment III, where it caused injury to the seed, with a resultant poor and delayed germination (Tables II and III, Fig. 4). It controlled damping-off caused by *Corticium*, but failed to control *Pythium*.

(5) *Acetic Acid, 1 per Cent. Solution.*

This also was tested in Experiment III, but gave only partial control of both damping-off fungi (Tables II and III, Fig. 3).

(6) *Boiling Water.*

Treatments with boiling water were carried out in Experiment II. Applied at the rate of 1 and 2 gallons per box, it failed to control *Pythium* (Table I, Fig. 5).

(7) *Cheshunt Compound, 0·3 per Cent. Solution.*

This treatment failed to give any control of *Pythium*.

(8) *Potassium Permanganate, 1 per Cent. Solution.*

This treatment, tested in Experiment I, failed to give control of *Pythium*.

(9) *Organic Mercury Compounds.*

Uspulun 0·25 per cent. solution in Experiment I and 0·5 per cent. solution in Experiment IV, Aretan 0·5 per cent. solution in Experiment IV, and Brassisan dust (applied at the rate of ½ oz. per box) in Experiment IV were used for the control of *Pythium*. All treatments had a depressing effect on germination and failed to control damping-off (Table IV).

(10) *Shirlan W.S., 0·25 per Cent. Solution.*

This solution applied to *Pythium* inoculated soil failed to control the disease.

RECOMMENDATIONS.

In dealing with a disease such as damping-off, where infection may under certain conditions spread rapidly through the soil from plant to plant, it is necessary that any treatment applied should give complete control of the disease. Thus, of the treatments tested, only two can be recommended—namely, steam-disinfection and the application of 1·25 per cent. formalin solution.

Steam Disinfection.

Where the facilities are available, this is undoubtedly the most convenient method of treating large quantities of soil for the control of damping-off. A temperature of from 180° F. to 200° F. for twenty minutes has been found to give efficient control of the disease.

Formalin, 1·25 per Cent. Solution.

Where steaming facilities are not available formalin treatment may be employed. The soil should be saturated, and the excess solution drained off. The soil should then be allowed to stand, with occasional

forking over to assist in drying, until all the formalin has disappeared. The formaldehyde has all evaporated when its pungent odour can no longer be detected. This takes at least two weeks.

After both treatments care should be taken to avoid recontamination of the soil.

SUMMARY.

(1) Tomato-seeding damping-off in New Zealand has been shown to be caused by the fungi *Pythium ultimum* and *Corticium vagum*.

(2) *P. ultimum* was found to be of greater incidence and to cause more severe injury than did *C. vagum*.

(3) A number of soil treatments were tested out and the results tabulated.

(4) It has been shown that damping-off is more severe and more difficult to control in soil which has been steam-disinfected before fungous cultures have been added to it.

(5) Steam disinfection and treatment with formalin, 1·25 per cent. solution, are recommended for the control of damping-off.

PAMPAS GRASS (*CORTADERIA SELLOANA*) AS FODDER.

RECENT INVESTIGATIONS.

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SINCE the article on "Pampas Grass as Winter Cow-feed" appeared in the May, 1934, issue of the *Journal* some progress has been made in investigating both the chemical and the cultural aspects of this plant, the correct botanical name for which (*Cortaderia selloana*) we are indebted to the Director of the Royal Gardens, Kew (Sir A. W. Hill, F.R.S.).

A paper by F. B. Shorland, Analyst, Chemistry Section, in the December, 1935, issue of the *New Zealand Journal of Science and Technology* deals with the chemical composition of mature leaves and the succulent leaf bases of pampas. He found that pampas herbage contains about 40 per cent. of cellulose, 19 per cent. to 24 per cent. of hemicellulose, and 17 per cent. of lignin, besides 7 per cent. to 10 per cent. each of ash and protein. The large amount of cellulose, which is 50 per cent. to 100 per cent. higher than in common pasture plants, together with the hemicellulose, sugars, &c., make this predominantly a carbohydrate fodder. The lignin, which is present to about the same extent as in ordinary grasses, is usually considered quite indigestible, but according to Woodman and Stewart it also has an adverse and variable effect on the digestibility of the other constituents.

Lignin occurs in intimate association with cellulose, these constituting together the greater part of the fibre or cell-wall constituents, and lignin, being itself indigestible, exerts a protective effect against the action of digestive juices on the remainder of the tissues. Where, however, as in pampas, the same amount of lignin is spread over a much larger amount of cellulose, the protective action of the lignin will be diminished.

In ruminants the digestion of fibre is carried out by bacteria in the rumen and other parts of the alimentary canal, which break it down into sugars, organic acids, and gases. The sugars and organic acids are assimilated to a varying degree while the gases escape, but on the basis of feeding-trials it has been found that cellulose has a feeding-value equal to starch.

The fineness of the fibre in pampas and the brittleness of the leaves doubtless contribute to its evident high digestibility. Preparations of crude fibre made from average-quality hay and from pampas showed the pampas fibre to be very soft and fine compared with that from hay which contained many harsh lignified fragments.

Pampas contains only about 10 per cent. of protein, but this is probably of good quality, being part of the substance of the living-cell contents and not a reserve or waste product, both of which classes of nitrogenous materials in other plant-foods, such as tubers and seeds, are frequently of unbalanced composition or sometimes, in quantity, injurious.

It would appear from these considerations that as supplementary fodder, the feeding-value of the dry matter of pampas-grass would be greater than that of average-quality hay, especially when used in conjunction with heavily top-dressed pastures. Early spring pasture-growth is rich in proteins and minerals, but is poor in dry matter, and in carbohydrate or "energy food." Top-dressed pastures in the Waikato, for instance, frequently have more than 30 per cent. protein in the dry matter, which if fed by itself is wastefully rich, especially at a season when carbohydrate is required for heat-production in cold weather.

In contrast to such crops as turnips, kale, or pumpkins, pampas is available whenever required, and does not, when established, deteriorate as other supplementary tall crops do by lodging in high winds or heavy rains. Its requirements in regard to surface-soil moisture, soil texture and fertility, and climatic conditions are less circumscribed, and its culture, when established, much simpler. It is a mistake to suppose that pampas is suited only to inferior-quality soil. The soil of the Hauraki Plains is one of the richest in New Zealand, and that of Kaharoa one of the poorest pumice. Pampas is doing well and is palatable to stock on both types of soil. Pampas does not require fertilizer—indeed, it is suggested by some experiments that fertilizer even does harm. In the growth of pampas only one anxiety need trouble the farmer—that arising from the suspicion that his fences are hardly strong enough to resist the great desire of stock to break them down in order to get at the young pampas. Many instances have shown that uncontrolled grazing by cattle will kill out the clumps of pampas.

It is suggested that pampas will be found useful in stump country, where ploughing is impossible and often soft-fodder crops cannot be grown. The use of pampas may, therefore, considerably shorten the time taken to break in bush land to dairy-farming by the present practice of felling the forest, burning off, surface-sowing the grass, allowing the stumps to rot, which takes twenty or more years, before logging-up and burning the stumps, ploughing and growing supplementary fodder crops. (Fig. 1.)

The authors do not consider it proved that any variety of pampas is unpalatable. Of course, an overgrown plant many years old may present physical difficulty to grazing by stock unless first cut down

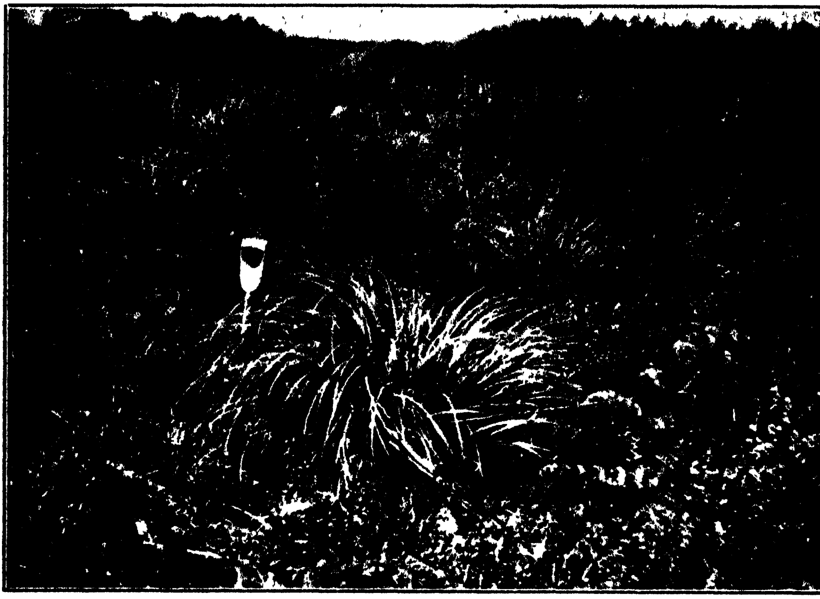

FIG. 1. GROWTH IN DECEMBER AT FRANKTON JUNCTION OF PAMPAS GRASS WHICH WAS FED-OFF IN WINTER

FIG. 2. PAMPAS GRASS NEAR HAMILTON.

and allowed to form new growth, while stock unused to pampas may not immediately attack a plant unless encouraged to do so.* The season of the year and the condition and nature of the pasture forming the bulk of the grazing for the stock also need to be taken into account.

For instance, at Whangarei on the large estuarial reclamation near the town, where seedling pampas covers an area of several acres, and whence already upwards of 100,000 plants have been removed for replanting without noticeable thinning of the stand, a few cows or calves are apparently grazed intermittently. Such a large surplus of pampas fodder is available that only a bush here and there is considerably grazed, the rest being only nibbled, while a very small proportion of clover and other grasses between the pampas is more freely eaten. Were enough stock put on to cope with the growth of pampas, there is little doubt that every bush would be grazed down, and it is stated on reliable authority that this has happened on several occasions to more than one area of seedling pampas on the reclaimed mud-flats, the pampas being killed right out by continual grazing.

Further proof of the general palatability of unselected pampas is afforded by a plantation of 4 acres near Hamilton, which the owner stated was obtained from various old clumps existing (for ornamental purposes) in gardens of the surrounding district. Of the three breaks into which the stand is fenced, two had been grazed this winter. Every plant appeared to have been eaten right down to the crown and a vigorous new growth re-established. Fig. 2 shows on left of fence the ungrazed break, and on right the grazed break with new growth. The owner stated that the cattle "wolfed" the pampas, and showed no evidence that any plant was unpalatable.

The authors would be pleased to receive any root cuttings of pampas which is definitely thought to be unpalatable. They very much doubt if such exists. Cultivated pampas should be prevented from flowering, which diminishes the vitality of the plant.

On a property near Frankton an extensive experiment with the object of comparing pampas of various origins is being carried out by a farmer. Seedlings from Whangarei, as well as root cuttings from three different sources, have been planted in adjacent strips. The Whangarei seedlings, after dying back to the ground, are making vigorous new growth, but it was noticeable that in many cases the plants had been grazed back, presumably by rabbits or hares, as larger animals were excluded.

Several other plantations of seedlings, including one near Waipawa, Hawke's Bay, on river silt, showed the same characteristic of dying back to the crown before putting up new growth†. This does not always happen, however, especially if the seedlings are under about 6 in. in height, as a number of tiny seedlings transported to Wellington have made vigorous growth without suffering check. (See Fig. 3.)

* Stock are often very shy in taking to a strange food, even although it may be one well recognized in other districts and of good nutritive value.

† Planted in October, 1935, when seen early in December these seedlings, in most cases, had only a small green top appearing among the dead leaves. When revisited during the second week in April, 1936—*i.e.*, four months' growth—an amazing change had occurred. Many of the plants had developed into tussocks or clumps over a foot in diameter at the base, with a score or more of shoots having leaves up to 6 ft. long. These plants appeared able to well withstand grazing the first winter after planting.

Over 70 per cent. of seed collected at Whangarei and raised in Wellington germinated, and the seedlings, planted out when about 4 in. to 6 in. high, have made continuous growth.

For any one desiring to make extensive plantations of pampas, wild seedlings or seed (when commercially available) should provide the most economical and most certain method. Seed is best raised in a box in gentle heat, using very sandy soil, so that the fine roots can be shaken out without damage. The seed should be germinated on the surface and not covered by soil. If the ground were well cultivated and freed from weeds, it would seem that the most rapid establishment would

FIG. 3. PAMPAS PLANTS NINETEEN MONTHS FROM SEEDLINGS

result from planting the seedlings out directly from the seed-box, when a few inches high, but otherwise, if grown-on for a season in a nursery bed, they should be moved to their permanent positions as rapidly and with as little disturbance of the roots as possible

Pampas root-cuttings should be planted with the above-ground stem at an angle of 45° with the surface, so that water and frost affect the butt less than if planted at a right angle with the surface. Drought is a great enemy to the establishment of pampas, and it is unfortunate that the drought of 1934–35 summer caused so many failures in attempts to establish plantations by means of root-cuttings in Hawke's Bay and Manawatu districts.

Discussion and Summary.

Accepting as true that there is no such thing as unpalatable pampas, the refusal upon occasion of cattle to eat pampas being capable of explanation on grounds other than that of palatableness, the very best

method for any farmer to adopt is to raise his own seedlings and plant them out in a well-fenced enclosure before the critical period in the growth of the seedling arrives at which on transplanting it dies down to the root. That this may be done has been amply demonstrated in laboratory and in garden by the authors. Seed threshed out of Whangarei pampas-plumes has given a 72-per-cent. germination test, and when the seed is merely laid on the surface instead of being covered with the soil a good braird results. Therefore the ideal way for the farmer to establish a pampas plantation of some acres would be to have the paddock which is the site of the plantation ready for the reception of the seedlings when they are sufficiently strong to be planted out 6 ft. apart or approximately at the rate of 1,000 plants per acre. This should be in the late spring or early summer, the exact time depending on local climatic conditions which, of course, may vary from season to season. The paddock must be securely fenced off. Should stock gain access they will graze and destroy the young plants in spite of abundance of other feed in the vicinity. The soil should be well worked, in good tilth, and free from weeds, and must be kept so until the seedlings are sufficiently advanced in growth to compete with the weeds, which, once the pampas is established, will speedily be crowded out. Thereafter no anxiety need trouble the farmer as to noxious weeds such as ragwort, &c., as the pampas will overshadow them.

Under favourable conditions, especially as regards soil-moisture, young plants will make rapid growth. After the first grazing, which will not be earlier than some time in the second year after planting out, the portion grazed must be shut up, and the growth from the butts will be extremely rapid.

In mid-summer in a Karori (Wellington) garden a row of plants in their second year had to be cut back to the ground as they were shading the adjoining plants excessively; twenty plants yielded 25 lb. of green matter. Three months later is was again necessary to cut the row of seedlings to ground level, the weight given being 23 lb. The cut stems continued to grow so that in an hour's time a difference in the stem from flatness to convexity could clearly be seen, and in a week's time there was 8 in. of yellow-green leaf, which in the following fortnight gained the usual green colouring of the plant. Statements that the plant will grow 1 ft. a month after grazing are therefore well within the mark. A photograph taken one calendar month after cutting in mid-summer shows fully 2 ft. of growth in the month.

The advice to work with the youngest possible seedlings in establishing a plantation is not given without experience. Every time one of the authors has visited Whangarei a batch of tiny wild seedlings has been brought back to Wellington, and these when planted out have all taken at once to their new environment, surviving without mortality or appreciable check in growth. On the other hand, the planting-out of clumps of the mature tussock subdivided to ensure that a portion of root is present often results in high mortality. This is especially the case when a droughty summer follows the planting as unfortunately was the case in Hawke's Bay and Manawatu districts during the summer of 1934–35, which prejudiced many farmers against pampas. In all probability had seedlings instead of subdivisions of the mature plant been planted out, and the usual precautions exercised, all the plants would have survived, as they did in Wellington during the same droughty

summer. Farmers must be particularly warned against assuming that because the above-ground portion of the plant is dead the roots also are dead. *A dead appearance of the young plant or root-cutting may persist for six months and yet finally green shoots develop from the roots.*

The difficulty of obtaining supplies of seed has yet to be overcome, but what has been done on a laboratory scale will doubtless be achieved on a manufacturing scale as soon as the demand arises. At present only uncleaned seed is obtainable from the English seed house of Sutton and Sons, Reading, at 12s. 6d. per pound, and the supply, even of this, is limited. Dobbie and Co., Edinburgh, also sell packets of seed. There is some evidence that cleaned seed—*i.e.*, seed freed from the surrounding chaffy matter—decreases rapidly in germinating-capacity, so that there may be a good reason for importing uncleaned seed if it has to be imported. Wild seedlings are obtainable from Whangarei by the courtesy of the secretary of the Whangarei Harbour Board, to whom inquiries should be addressed, at 30s. per thousand f.o.b. or f.o r., Whangarei. The seedlings are packed and forwarded under the superintendence of a skilled nurseryman.

The behaviour of the pampas-plants other than mere seedlings is extraordinary for a grass or even an evergreen plant. Usually one may expect the whole of the above-ground portion to die right back and the dead leaves to remain for several months ; finally a shy green growth appears in the clump of dead leaves, and this new growth gradually strengthens until the plant is thoroughly established. The danger is that farmers, seeing nothing but dead leaves persisting for months in their plantations, may wrongly assume that the whole plant is dead and plough the site up again, or may even allow the weeds to take charge, stifling out the young growth.

Mr. C. R. Taylor, in charge of the experiments at Rotorua, reports that if extreme care be taken not to disturb the roots quite large plants raised from seed may be transplanted without dying back, and suggests that if seedlings are grown in an enclosure adjoining the paddock to contain the pampas plantation it may be possible to obtain much better results by transplanting with the minimum of disturbance to the roots. The advantage of using plants derived from seed or wild seedlings over plants raised from subdivisions of old clumps is that the last kind of plants do not stool out quickly enough and are therefore, in this respect, inferior to seedlings, which make early and rapid growth in all directions and so help to smother weeds, which in the first year are such a menace to the young pampas-plants spaced 6 ft. apart. (Fig. 4.)

CONCLUSIONS.

Pampas plantations are best raised from seed germinated in shallow boxes on the surface of a light, sandy soil such as pumice, transplanted to a well-tilled soil, and when they are about nine months old planted out in a strongly fenced cultivated area at the rate of 1,000 plants to the acre—that is, in rows so that a plant is approximately 6 ft. from any other plant. They must not be grazed until near the end of the second year after being established in the paddock. During this time the land should be kept free from weeds. After this the pampas-plants will look after themselves and successfully compete with the weeds.

FIG. 4. PAMPAS-GRASS SEEDLINGS PLANTED IN THE AUTUMN, 1935 AND PHOTOGRAPHED THE FOLLOWING MID-SUMMER.

FIG. 5. PAMPAS SEEDLINGS, SIX MONTHS OLD, RAISED FROM WHANGAREI SEED.
There are great variations in the seedlings, all of the same age.

The next best method is to obtain the *smallest possible wild seedlings* from Whangarei and plant these out in the site of the required plantation. Seedlings may be planted in spring and autumn.

The most precarious method of establishing a plantation is by means of subdivisions of existing mature clumps, as, owing to the danger of a drought killing the cuttings, heavy mortality may be experienced. Such cuttings should be obtained from vigorous shoots, and should not be taken from portions that have borne flowers ; the outside portions of a clump supply the best shoots. Cuttings should be planted in spring, when danger of frost is over and when the soil is moist. Cuttings must be planted at an angle of 45 degrees with the surface : if planted upright, water may rot the crown. Pampas is a sun-loving plant—a light-demander. It must be kept free from smothering-weeds in the early days of establishment.

With regard to all plantations, stock must not be allowed to graze the plants too hard during the first grazing, neither must the plants be allowed to flower, as this would considerably weaken the vegetative development of the whole plant. It is unnecessary to manure pampas unless unsatisfactory results indicate that some form of soil-enrichment is necessary.

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CONTROL OF RUSHES BY MOWING.

THE following statement by Mr. E. C. Holmes, Te Hopai, Featherston, describes instructive experience :—

" I was much interested in the advice about rush-control on page 49 of the January, 1936, *Journal*. I farm on the wet lands bordering Lake Wairarapa. Some seven years ago I began to mow my rushes, which over many acres were so dense and high that a horse could hardly get through them, let alone sheep. To-day the rushes are reduced to small weedy clumps, hollow in the centre. None of the land has proper drainage, nor can it be got. This land now carries three to four ewes to the acre. I mow some 600 acres to 800 acres a year. Several paddocks now have to be mown only every second year, and, again, in some places the rush has disappeared. I like to mow when the seed is fully developed . the young second growth that comes in the autumn the cattle will nip off in the winter, and so one gets a second cut free of cost. If possible, I top-dress after cutting : top-dressing encourages the stock to eat the rush, but obstinate cases I cut in December and again in March. I am careful to leave shelter-belts for use in lambing. I have had heavy losses with spring lambs through completely ' cleaning up ' the paddock. In my particular case rush-mowing has been a great success, and is part of the farm routine work."

DR. C. J. REAKES ADDRESSING A RECENT GATHERING OF FARMERS AT WALLACEVILLE VETERINARY LABORATORY.

RETIREMENT OF DR. C. J. REAKES, DIRECTOR-GENERAL OF AGRICULTURE.

AFTER thirty-nine years as a member of the staff of the Department of Agriculture, C. J. Reakes, Esq., C.B.E., D.V.Sc., M.R.C.V.S., retired on 30th April, 1936. During the latter eighteen years of his term of service he guided the destinies of the Department as its Permanent Head.

C. J. REAKES, C.B.E., D.V.SC., M.R.C.V.S.

In the House of Representatives the Minister of Agriculture, the Hon. W. Lee Martin, in announcing that Dr. Reakes had tendered his resignation, expressed on behalf of the Government its deep appreciation of the successful manner in which Dr. Reakes had carried out his duties, and paid a tribute to his zeal, courtesy, and devotion to duty. The remarks of the Minister were endorsed by the Right Hon. G. W. Forbes, leader of the Opposition.

After a distinguished scholastic career and considerable professional experience overseas, Dr. Reakes arrived in New Zealand from England in 1897, and was appointed to the Department of Agriculture as a veterinary surgeon. In 1901 Dr. Reakes was appointed Assistant Chief Veterinarian.

When the Veterinary Laboratory was established at Wallaceville it became the centre for the veterinary research work of the Department and headquarters of the Veterinary Division. In January, 1909, Dr. Reakes was appointed Chief Veterinary Surgeon in succession to Dr. Gilruth, who resigned to take up a position in Australia. Dr. Reakes at the same time succeeded Dr. Gilruth as Director of Veterinary Services in the Defence Department.

In 1910 Dr. Reakes was granted the degree of Doctor of Veterinary Science by the University of Melbourne, and when the Department was reorganized during this year he was promoted to the position of Director of the Live-stock Division.

On the outbreak of war in 1914 Dr. Reakes devoted his services to the work of the Defence Department in connection with the purchase of remounts, the supervising of fodder-supplies, and the transport for the horses. Later he was associated with the requisition of meat, wool, dairy-produce, and other supplies for the British Government. In 1919 he was created C.B.E. (Military Division).

In more recent years Dr. Reakes twice visited Great Britain officially in connection with the frozen-meat industry and agricultural research, attending conferences in London.

On 30th April last a large gathering of officers of the Department of Agriculture, with many others, took farewell of Dr. Reakes, when the Minister of Agriculture, the Hon. Mr. W. Lee Martin, made a presentation on behalf of the Department to Dr. and Mrs. Reakes. The Minister made reference to the reliability and grip of his work possessed by Dr. Reakes as Director-General, and pointed out that when Dr. Reakes joined the Department the staff totalled only 106, whereas it was now 529.

Mr. A. H. Cockayne, who presided, supplemented the remarks of the Minister in giving tribute to Dr. Reakes, and commented that his period as Director-General coincided with unparalleled expansion of the Dominion's agricultural activities.

The industry, tact, courtesy, and good will of Dr. Reakes are well known to and appreciated by the farming and business communities of New Zealand, all sections of which will join with the staff of the Department of Agriculture in wishing him many years of well-earned leisure.

—*Wm. C. Robinson.*

CRITICAL STUDY OF IMPORTANT FACTORS IN SUCCESSFUL PIG-KEEPING.

ANALYSIS OF LITTER RECORDS OF THE MANAWATU-OROUA PIG DEVELOPMENT AND RECORDING CLUB FOR THE YEARS 1932-35.

C. P. McMeekan, Massey Agricultural College, Palmerston North.

In the first annual report of the club in 1933(1) an analysis of the litter records completed during the first year of operation was presented. This provided valuable data as to the varying standards of productive efficiency of the herds and individual breeding-stock of recording members, together with some information as to the most important factors

associated with good results. Unfortunately, the limited number of litters upon which the investigation necessarily was based limited also the information derived; the work of the past two seasons, however, has made available some 300 additional litter records, and has provided the material for a more comprehensive and reliable study of some of the factors of importance in successful pig-raising.

Table 1.—Summary of Litter Averages

Period ending	Number of Litters	Average Number per Litter.			Mortality.		Average Litter-weights in Pounds at			
							Twenty-one Days		Fifty-six Days.	
		Born.	Born alive.	Weaned.	*(1).	†(2).	Total.	Per Pig	Total.	Per Pig.
					Per Cent.	Per Cent				
March, 1933 ..	117	9·6	9·2	8·1	16·1	12·5	102	12·7	308	38·2
March, 1934 ..	118	9·2	8·6	7·7	15·8	10·0	97	12·2	290	37·5
March, 1935 ..	200	9·9	8·8	7·8	20·8	10·6	102	13·0	289	37·0
All records ..	435	9·6	8·8	7·9	18·3	11·0	100	12·7	295	37·5

* (1) Mortality-rate based on total pigs born i.e excluding still-born pigs † (2) Mortality-rate on pigs born alive

In Table 1 the average results from all litters recorded are shown for each year, together with a summary for the whole three-year period. By 31st March, 1935, the records of 435 sows were completed. These yielded the very good litter average of approximately 8 pigs weaned, 100 lb. per litter at twenty-one days, and 295 lb. at fifty-six days, while the average weight per pig at fifty-six days was 37·5 lb.

Since such figures provide a measure of the prolificacy and milking-capacity of the breeding-stock, the rate of maturity of the progeny, and the efficiency of feeding and management of the farmer, it is extremely satisfactory to note that in these respects the standard of pig-production in the Manawatu district amongst recording farmers compares very favourably with that of the Waikato and Canterbury areas, where litter-testing has also been carried out. It is also worthy of note that the results show an improvement over the results obtained in the Manawatu district in 1928, when 121 litters produced an average of 7·3 pigs weaned, 80 lb. per litter at twenty-one days, and 229 lb. at fifty-six days, with an average weight per pig of 31·5 lb.(2)

YEARLY VARIATION.

Little significant difference occurs in the yearly averages; what difference there is shows a falling-off rather than an improvement in efficiency. Though this result on the surface is disappointing, it may be attributed safely to the following facts: (*a*) During the first year the 117 litters recorded included sixty-six litters from one herd in which the standard of stock and management was extremely high—the results contributed largely to the high averages of that year. Corresponding litters from this herd have not since been recorded owing to limitations of the club's finance. (*b*) The first year's operations covered mainly established pig herds; those of the latter years, largely newly formed herds. This is borne out by the fact that during the first year

the records included only 20 per cent. of maiden litters, while during the last two seasons 61 per cent. of the litters recorded were from maiden sows. (c) Since the litter averages of maiden sows tends to be lower than those of older breeding-stock, the increased number of the former is alone sufficient to account for the slight reduction in results. (See Table 8.)

Variation between Individual Litters and Herds.

While the average results indicate a satisfactory standard of general efficiency, examination of individual litter results indicates that extremely wide differences occur, and emphasizes the importance of litter-recording work in indicating to farmers just where and how their methods of pig-production are succeeding or failing and in locating profitable and eliminating unprofitable individuals and strains of breeding-stock.

Table 2.—Maximum Range of Differences in Litter Records.

—	Highest.	Lowest.
	lb.	lb.
Total litter-weight at twenty-one days	175	24
Average weight per pig at twenty-one days	21	6
Total litter-weight at fifty-six days	544	77
Average weight per pig at fifty-six days	56	15

While Table 2 emphasizes the tremendous range of differences existing between individual litters, a more effective picture of the extent and nature of such differences is shown by Tables 3 and 4, in which the litters are grouped according to the weight of the litter at fifty-six days. The litters dealt with in Table 3 showed the following broad distribution: (1) over 400 lb., 9·5 per cent.; (2) over 350 lb., 26·5 per cent.; (3) over 300 lb., 48·4 per cent.; (4) over 250 lb., 70·0 per cent.; (5) over 200 lb., 85·9 per cent.

Table 3.—Litter-production Total Litter-weight.

Group Class.	Number of Litters.	*Average Number born.	Average Number weaned.	Average Litter-weights in Pounds at Twenty-one Days. Total.	Twenty-one Days. Per Pig.	Fifty-six Days. Total	Fifty-six Days. Per Pig
Lb							
100–150 ..	16	7·1	4·3	44·3	10·3	120	27·8
150–200 ..	42	8·0	5·8	62·1	10·7	178	30·7
200–250 ..	65	9·2	6·8	75·5	11·2	226	33·4
250–300 ..	90	9·1	7·5	88·2	11·7	280	37·2
300–350 ..	90	9·9	8·6	105·0	12·2	330	38·3
350–400 ..	70	10·9	9·4	120·3	12·9	369	39·4
400–450 ..	27	11·1	10·1	125·8	12·5	422	41·9
450–500 ..	7	12·6	11·9	131·0	11·5	465	40·7
500–550 ..	5	11·8	11·0	143·0	13·0	525	47·7

* Born alive.

Note.—The increase in total litter-weight is brought about mainly by an increase in the numbers weaned per litter, but not entirely, since the individual weight of the pigs is greater in the heavier litters both at twenty-one days and at fifty-six days.

Table 4.—Comparison of Litters above and below 300 lb. at Fifty-six Days.

Group.	Number of Litters.	*Average Number born.	Average Number weaned.	Average Litter-weights in Pounds at Twenty-one Days: Total.	Twenty-one Days: Per Pig.	Fifty-six Days: Total.	Fifty-six Days: Per Pig.
Below 300 lb...	212	8·8	6·7	80	11·2	236	35·1
Above 300 lb.	199	10·6	9·3	115	12·3	368	39·7

* Born alive.

The Importance of Heavy Litters.

For economic reasons the *total litter-weight at fifty-six days* is perhaps the most important measure of efficiency of a breeding-sow. The sow which can produce regularly the greatest weight of pig-flesh at weaning-time, providing the pigs are of the right market quality, is the most profitable sow to the producer, whose aim therefore should be the attainment of good results in this respect. Heavy litters being associated with heavy individual pigs not only are important in themselves, but have a definite relationship with the subsequent rate of growth of the animals, heavier weaners retaining their more rapid rate of growth right through to the market stage.

Tables 3 and 4 illustrate the wide differences existing in total weaning-weights, a considerable number of litters ranging from 150 lb. to 450 lb. at eight weeks. Since the records have been obtained over a wide range of farms and breeding-stock, fed and managed under practical farming conditions, the results show that a *standard of 300 lb. per litter* at fifty-six days is a reasonable expectation from a breeding-sow. Approximately 50 per cent. of the sows tested attained this production.

If such a standard can be accepted, it provides a useful measure of efficiency which farmers may well employ in their pig-keeping operations, just as they now employ a similar standard in their cow-keeping practices, *i.e.*,—

A good cow produces 300 lb. butterfat per annum :
A good sow produces 300 lb. pig-flesh per litter.

The differences between individual sows and litters are similarly apparent between different herds. Thus Table 5 compares the " best " herd with the " worst " herd under test.

Table 5.—Comparison of Best and Worst Herd.

——	Number of Litters.	*Average Number born.	Average Number weaned.	Mortality.	Litter-weight at Fifty-six Days.
				Per Cent.	
Herd A ..	47	8·3	7·7	10	330 lb. : Average 43 lb.
Herd B ..	20	8·8	6·0	27	200 lb . Average 34 lb.

* Born alive.

Though the "worst" herd had more pigs born per litter, a mortality rate of 27 per cent. considerably reduced the number weaned. This, combined with a lower weight per pig, gave the "best" herd a 65-per-cent. superiority in total litter-weight and a 26-per-cent. superiority in weight per pig, despite the fact that the figures cover more than twice the number of pigs in the latter herd.

It might be noted that herd A has been recorded each year and is one in which selection and culling, feeding and management methods have been guided largely by recording results. (In Table 13 there is given an example of sow A, which was taken from this herd.) The herd thus provides an excellent example, and by no means an isolated one, of the importance of continuous testing in the attainment of a high standard. Testing but one year cannot provide a sound basis for pig-improvement any more than testing dairy stock for one season can produce much effect upon the standard of dairy production.

Relative Importance of Number and Weight of Pigs upon Litter-weights.

Since the total weight of a litter is dependent upon the number of pigs weaned and the individual weight of the pigs at weaning-time, the pig-raiser, to secure heavy litters, must aim at both (*a*) large litters, and (*b*) heavy weaners.

Examination of Tables 3 and 4 gives additional weight to this point, the heavier litters being secured by a combination of both large numbers weaned and heavy pigs.

Furthermore, Tables 3 and 4, together with Table 6 below, show that (*a*) the number of pigs weaned is more important in securing heavy litters than is a heavy weight per pigling; both, however, are necessary: (*b*) that the individual weight of the weaner is not dependent upon the number of pigs in the litter.

Table 6.—Litter-production: Number of Pigs weaned.

Number weaned.	Number of Litters.	Number born alive.	Average Litter-weights in Pounds at Twenty-one Days. Total.	Twenty-one Days. Per Pig.	Fifty-six Days. Total.	Fifty-six Days. Per Pig.	Range of Average Litter-weight per Pig. Maximum.	Minimum.
							lb.	lb.
3 ..	6	7·6	39	13·1	164	36·3	46	26
4 ..	13	6·0	51	12·7	172	43·0	51	29
5 ..	28	7·5	62	12·5	197	39·5	50	28
6 ..	48	8·5	73	12·2	234	39·1	54	27
7 ..	73	8·4	87	12·4	264	37·7	56	15
8 ..	79	9·7	98	12·2	298	37·1	56	21
9 ..	88	10·4	106	11·8	339	37·8	50	21
10 ..	56	11·3	119	11·9	380	38·0	53	23
11 ..	13	11·8	125	11·4	394	35·8	50	29
12 ..	8	12·3	128	10·7	459	38·2	45	25

NOTE.—The average weight of pigs in litters of ten is not materially less than the weight of the individual pigs in litters of five—that is, it is possible to obtain pigs averaging 50 lb. at eight weeks in litters of ten and eleven as well as in litters of five and six.

THE EXTENT, NATURE, AND IMPORTANCE OF MORTALITY.

Apart from the fundamental and hereditary quality of prolificacy, which primarily determines the number of pigs born, the mortality-rate within a litter is the governing factor affecting the number of pigs weaned. All the foregoing tables emphasize the importance of the mortality-rate in this respect. Examination of the records in detail in respect to the nature and extent of the mortality is therefore of considerable interest, especially since many deaths in young pigs could be eliminated by efficient management.

Table 7.—Mortality Details.

—	1933.	1934.	1935.	Total.
Total number born ..	..	1,084	1,980	3,190
Still-born	(No data)	69 = 6·4%	227 = 11·4%	402 = 9·6%
Total number born alive	1,079	1,015	1,753	3,847
Number of runts ..	35 = 3·2%	23 = 2·3%	22 = 1·3%	80 = 2·1%
Number overlain and/or died	110 = 10·2%	79 = 7·8%	164 = 9·4%	353 = 9·2%
Number weaned ..	934 = 87·0%	913 = 90·0%	1,567 = 89·4%	3,424 = 89·0%

It is necessary in examining mortality figures to distinguish between the total number of pigs born and the total number born alive. Still-born pigs are a common occurrence in pig-breeding, and are considered to be due partly to heredity and partly to nutritional defects or deficiencies. By avoiding strains showing this tendency and by paying due attention to the feeding of the sow at all times it is possible to reduce such losses to a minimum.

It is apparent from Table 7, however, that still-born pigs are of considerable importance, an average of nearly 10 per cent. being certainly a limiting factor to high weaning averages. In one herd in particular the average for some twenty-four litters was 20 per cent., a figure which reduced the number weaned to an average of seven pigs, although over nine per litter were actually born.

In respect to pigs born alive, approximately 2 per cent. were classified as "runts," and are not included in the weaning results. Of the remainder, approximately 9 per cent. were either overlain or died before weaning. Of this number, the majority were overlain, only 2·6 per cent. of the total number born alive dying from other causes.

Taking runts, deaths from overlying, and other causes into account, the total mortality in pigs born alive was 11 per cent. for the whole period. This figure, considering the large number of litters involved, must be considered fairly satisfactory, but it must also be emphasized that many deaths from overlying and other causes, and even many supposed cases of still-born pigs, can be eliminated by efficient management. The experience and observation of the recording officer has shown that better attention at farrowing-time, the provision of more effective housing and shelter, and better all-round management and feeding could result in the saving of many pigs. Individual herds still have mortality figures

of 30 per cent. and over, while, on the other hand, two herds, both handling more sows than the average farmer, have reduced the rate to 5 per cent. by increased attention to such matters.

THE EFFECT OF AGE OF SOW UPON EFFICIENT PRODUCTION.

Table 8 sets out the average results according to the number of the litter—*i.e.*, age of sow. Although it might be assumed from the frequency figures that the average life of a sow is only four to five litters, this is not justified, since, as stated above, the larger number of herds are but newly established, and the majority of sows relatively young. Even the older herds have increased their numbers of recent years with a similar result.

Table 8.—Litter-production : Number of Litter.

(Age of Sow.)

Number of Litter.	Number of Cases.	Average Number born.	Average Number born alive.	Average Number weaned.	*Mortality	Average Litter-weights in Pounds at Twenty-one Days.		
							Fifty-six Days.	
						Per Pig.	Total.	Per Pig.
					Per Cent.			
First ..	83	8·7	8·0	7·2	9·8	11·2	266	36·9
Second ..	54	9·4	8·7	8·1	8·8	11·8	302	37·4
Third ..	65	9·9	9·2	8·0	13·7	12·6	307	38·5
Fourth ..	57	10·0	9·3	8·2	11·7	12·5	319	38·7
Fifth ..	24	10·2	8·9	8·4	6·1	12·5	317	37·8
Sixth ..	15	9·9	9·5	8·3	12·0	12·7	315	37·9
Seventh ..	6	10·8	9·3	8·0	14·3	11·9	341	42·7
Eighth ..	..	..	..	..	..	..	..	..
Ninth ..	2	11·0	9·5	6·5	31·6	11·4	235	36·3
Tenth ..	1	11·0	9·0	9·0	.	11·0	339	37·6

* Based on pigs born alive.

The above figures can be considered useful only up to the sixth litter, the number of cases after the sixth being too few for comparative purposes.

Maiden sows weaned fewer pigs and produced a lower total litter-weight than sows carrying their second to their sixth litter. This is in line with similar observations overseas(3). No significant difference is apparent between second, third, fourth, fifth, and sixth litters in respect to weaning-weights. The number of pigs born seems to increase with age, though there is little difference in number weaned except as noted in the case of maiden sows. The few sows recorded in their tenth and eleventh litters indicate that it is possible for a sow to retain her breeding qualities to this stage.

EFFECT OF SEASON OF FARROW UPON EFFICIENT PRODUCTION.

Due to the seasonal nature of our supply of pig-foods, the month of farrow is frequently stated to be an important factor not only from the point of view of ease of management and avoidance of mortality, but also in respect to the securing of heavy litters. Many farmers claim that best results are obtained when the seasonal supply of milk is ample. Partly to investigate the truth of this contention, and partly because of the possible necessity of modifying the present management methods in respect to farrowing

dates due to the increasing importance of the baconer rather than the porker trade, the records have been grouped according to the month of farrowing. Tables 9 and 10 illustrate the position.

Table 9.—Litter-production: Season of Farrow.

(All records three-monthly periods.)

Season of Farrow.	Number of Litters.	Average Number born alive.	Average Number weaned	*Mortality	Average Litter-weights in Pounds at Twenty-one Days. Per Pig.	Fifty-six Days. Total	Fifty-six Days. Per Pig.
				Per Cent.			
June–August ..	130	8·8	8·0	8·8	11·5	290	36·0
September–November	87	9·0	8·1	10·6	11·8	312	38·4
December–February ..	126	8·9	7·8	12·1	12·2	309	39·4
March–May	57	8·5	7·5	11·6	12·5	270	36·0

Table 10.—Mortality Details: Season of Farrow.

Season of Farrow.	Still-born.	*Runts.	*Overlain or died.	*Weaned
	Per Cent.	Per Cent.	Per Cent	Per Cent.
June–August	9·0	2·4	7·8	89·8
September–November ..	5·0	1·6	9·4	89·0
December–February ..	6·7	1·4	9·7	88·9
March–May	12·5	2·4	8·5	89·1

* Mortality on a basis of pigs born alive.

Table 9 shows that there is little material difference between the different seasons in respect to either number weaned or total litter-weight, or average weaner weights. The autumn period, March to May, and the winter-early-spring period—June to August—however, show to a slight disadvantage. There appears to be a difference from year to year in this respect, the records showing that in the March to May period in 1933 the litter average was 303 lb., while in 1934 it fell to 240 lb. Similarly, the winter-early-spring period in 1934 gave an average of 301 lb. per litter.

Table 10 similarly shows little difference in mortality figures on a basis of pigs born alive. The percentage of still-born pigs, however, is greater in the autumn period and the winter-early-spring period than during the summer. This figure of a higher percentage of still-born pigs during March to May is interesting, and merits further investigation.

In connection with month of farrow, the following table shows the distribution of farrowings of recorded litters throughout the year.

Table 11.—Monthly Distribution of Farrowings.

Month.	Farrowings.	Month	Farrowings.
	Per Cent.		Per Cent
January	11·6	July	16·2
February	8·1	August	13·4
March	6·4	September	10·0
April	4·6	October	3·4
May	6·0	November	3·4
June	9·3	December	7·6

Farrowings are apparently fairly well spread throughout the year. At the same time, they show a close relationship to the seasonal milk-supply, and indicate that farmers are making an endeavour to arrange their breeding operations so as to have pigs available to consume the seasonal flush of feed during late spring and early summer. Thus the most favoured period is June to September and the corresponding months December to March. July and January seem the most popular months.

It would appear, however, that, from the point of view of efficiency of production to the weaner stage, there is little objection to advancing the breeding operations to a still earlier date in the winter and summer; such a policy would have definite advantages should it become necessary, as it appears from present market trends, to concentrate more along lines of baconer-production than porker.

The Influence of Breed and Strain upon Efficiency of Production.

A comparison of the different breeds and crosses has further illustrated the fact that there are no significant differences between the different breeds of pigs so far as efficiency of litter-production is concerned. The four pure breeds (see Table 12) gave similar results both in total litter-weight and average weight per pig. Slightly more pigs were born in the Large Black and Large White breeds, but this was compensated for by a higher death-rate.

Table 12.—Litter-production: Breed or Cross.

Breed.	Number of Litters.	Average Number born.	Average Number weaned.	*Mortality.	Average Litter-weight in Pounds at			
					Twenty-one Days.		Fifty-six Days.	
					Total.	Per Pig.	Total.	Per Pig.
PURE-BRED LITTERS.								
				Per Cent.				
Tamworth ..	79	9·6	7·9	16·8	95	11·8	313	39·2
Large White ..	54	10·7	8·0	26·2	92	11·5	290	36·1
Large Black ..	34	9·9	7·1	27·9	85	11·9	287	40·2
Berkshire ..	35	9·5	8·1	15·6	94	11·7	292	36·3
	202	9·9	7·9	21·2	92·5	11·8	300	38·0
FIRST-CROSS LITTERS.								
Tamworth × Berkshire	42	9·2	8·2	11·1	93	11·4	286	34·8
Tamworth × Large White	7	11·6	9·0	22·3	111	12·3	358	39·9
Tamworth × Large Black	11	8·4	7·3	12·1	95	12·6	308	42·3
Berkshire × Large Black	5	8·2	7·4	9·8	92	11·5	284	38·3
	65	9·5	8·3	12·8	98	11·8	306	36·8
PURE-BRED SIRE × GRADE SOW.								
Tamworth Sire ..	104	9·1	7·6	16·4	92	12·1	276	36·2
Large White sire..	7	11·1	9·3	16·7	103	11·1	315	33·9
Large Black sire..	13	10·4	9·0	13·4	113	12·6	340	37·7
Berkshire sire ..	21	9·0	8·1	9·0	101	13·0	320	39·8

* Mortality based on total pigs born alive or dead.

The pure breeds compared very favourably with the first-cross litters and the grade litters by the pure-bred boar. The figures do not, therefore, support the contention often made that it is necessary to go to the first cross to obtain prolificacy, thriftyness, and rapid rate of growth. There were also no wide differences within the first cross or the grade litters.

These figures should serve to emphasize the far greater importance of strain within the breed rather than of breed itself. It is apparent from the information presented in the foregoing tables that there exist far greater differences between different individuals within a breed. It is well recognized that such individual differences are carried to strains, some strains being more productive than others.

The data of the Recording Club, while providing a basis for the location of such "good strains," are still insufficient for a detailed strain analysis. Although many different strains are under test, the influence of the management factor is so great as to make the interpretation of strain differences upon but a limited amount of material extremely difficult.

The following example, however, provides a good illustration not only of a highly productive strain of a certain breed in the same herd, and therefore under the one management, but also of the ability of a sow to transmit high-producing qualities to her progeny.

Table 13.—Records of Sow A and Progeny

—	Number of Litters.	Average Number born.	Average Number weaned.	Weight in Pounds at Fifty-six Days.	
				Total.	Average.
Sow A	*4	8	7·0	316	44
Daughter B	†4	10	9·5	443	47
Average of four grand-daughters *ex* sow B	‡4	11	9·5	380	40

* Tenth, eleventh, twelfth, and thirteenth litters. † First, second, third, and fourth litters.
‡ All maiden litters.

These pigs are from a strain twenty-two litters of which in the same herd produced an average of 8·2 pigs weaned, 375 lb per litter at fifty-six days, and an average of 42 lb. per pig. Where pigs of similar breeding have come under test in other herds they produce consistently good results with reasonable management.

Litter Variation and the Effect of Size of Litter and Weaning-weight.

The production of good even litters which can be fed together and which are ready for market at the same age is of material economic importance. It is well recognized, however, that the individual piglets of a litter vary widely in weaning-weight—that they grow at different rates. Such differences are often primarily responsible for the marked lack of uniformity in the market weights of many lines of farmers' pigs reaching the slaughterhouse. This is especially so since few producers use the scales to determine the suitability of the weight of a pig for marketing, but rather market as "lines" the complete or nearly complete litter when the average reaches the approximate weight required.

It is therefore important to measure the extent of the variation in the individual weaning-weights of a litter. Such "litter variation" figures can be expressed on a percentage basis by the method employed by the East Anglia Pig-recording Scheme(3). In the litters under review considerable differences are apparent, the litter variation showing an extreme range of from 3 per cent. to 30 per cent., while the commonest variation occurred between 8 per cent. and 12 per cent.

To ascertain whether any connection exists between litter variation and the number of pigs in the litter, the variations have been grouped according to the number of pigs weaned. It will be seen from Table 14, however, that there appears to be no significant relationship. This result is in line with English experience(3).

Table 14.—Litter Variation and Number of Pigs weaned.

Number weaned ..	4	5	6	7	8	9	10	11	12
Number of litters ..	11	21	40	61	66	75	47	11	7
Average variation per litter (percentage)	11·8	9·6	14·4	10·0	11·1	9·9	13·0	8·6	9·4

On the other hand, comparison between the average weaning-weight and the litter-variation figures, as shown in Table 15, indicates that less variation exists in litters with a high average weaning-weight. Thus litters averaging less than 40 lb. per pig at fifty-six days show a litter-variation figure greater than 12 per cent., while litters averaging more than 40 lb. at weaning show an average litter variation of less than 9 per cent.

Table 15.—Litter Variation and Weaning-weight

Average weaning-weight in pounds	25	27½	30	32½	35	37½	40	42½	45	47½
Number of litters ..	9	19	27	36	47	67	50	38	27	16
Average variation per litter (percentage)	13·4	14·2	13·1	12·8	12·0	9·8	8·9	8·0	8·5	7·8

It would appear that the adoption of methods which will ensure heavy individual pigs at weaning has an additional advantage in that such litters will tend to be more uniform in individual weights.

Influence of Management on Efficient Production.

In the first report of the club the influence of feeding and management upon the efficiency of litter-production was emphasized. While the results obtained from litter-testing measure to some extent the prolificacy, the milking-capacity, and the capacity for motherhood of the breeding-stock, they also reflect very largely the feeding and management methods of the farmer.

The pig-recording work up to the present time suggests that the greatest limiting factor to efficient weaner-production is not the quality of the breeding-stock, but the quality of the management, and that the

large majority of farmers could effect marked and immediate improvement in their results from pig-breeding by a closer attention to their husbandry. At the present time it is clear from the fact that less than 50 per cent. of the litters even of recording farmers reach the standard suggested as practicable that there is a large and unprofitable "tail" to the industry.

For this reason the greatest value of litter-recording work lies in the light it throws upon just how and where the management of individual farmers is succeeding or failing. Good animals in themselves are not sufficient; they must be accompanied with good management if they are to express their inherent productive qualities. By continuous testing of performance, and by the application of the lessons provided, recording can be of material aid in the attainment of consistent and efficient results.

The major management factors which play a part in heavy litter-production are briefly—(1) Good feeding of sow and litter at all times; (2) the provision of the creep for the litter from three weeks onwards; (3) the rational use of concentrates for both sow and litter to supplement dairy by-products; (4) the provision of warm draught-proof houses; (5) provision of shelter; (6) access to clean short leafy pasture; (7) care and attention at farrowing; (8) care, regularity, and cleanliness in feeding.

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VACCINATION OF EWES AGAINST PULPY KIDNEY (INFECTIOUS ENTEROTOXAEMIA) IN LAMBS.

TRIALS IN CENTRAL OTAGO, SEASON 1935.

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IN the March, 1936, issue of the *N.Z. Journal of Agriculture* there appeared an article by Mr. Dudley A. Gill, M.R.C.V.S., D.V.S.M. —a summary of his paper entitled "Infectious Enterotoxæmia and the *Clostridium welchii* Group, with Special Reference to So-called Pulpy Kidney in Lambs," which was read at the 1935 Science Congress of the Royal Society of New Zealand.

In the original paper the author made a strong suggestion that trials should be made of a possible method of protecting lambs against pulpy kidney by the vaccination of the ewe with a formalinized enterotoxæmia (*Clostridium welchii*, type D) vaccine. Behind this was the idea of the transference of a passive immunity to the lamb through the medium of the ewe's colostrum, with the hope that any such immunity would be sufficiently lasting through the most important susceptible period—*i.e.*, between the third and fourth week of the lamb's life. Dalling and his colleagues, working in England on lamb dysentery, had demonstrated the presence of an antitoxin in the colostrum of ewes, following vaccination during

pregnancy with a vaccine prepared from the lamb dysentery organism (*Clostridium welchii*, type B). This antitoxin could also be detected in the blood of the lamb shortly after it had first suckled a vaccinated mother. By this method a high degree of protection was given to lambs from lamb dysentery, which previously caused heavy mortality in the first few days of life. Trials were undertaken in Central Otago during the 1935 season, in which pregnant ewes were vaccinated with a formalinized enterotoxæmia vaccine, and it is the purpose of this article to record the results obtained.

Vaccination Trials.

At the outset it was intended to vaccinate approximately 1,000 ewes and hold a corresponding number of controls on farms where the disease in lambs had been known to exist in former seasons. The vaccinated ewes were to depasture together under identical conditions.

It was proposed to give the ewes two doses of vaccine, the first dose approximately six weeks before lambing and second dose a week or ten days before lambing. However, owing to the vaccine not being available in time, this intention could not be followed strictly, and the above intervals had necessarily to be shortened. In September, 1935, the first dose of vaccine was given to 1,370 ewes. The particulars are shown in Table I.

Table I

Farm.	Ewes vaccinated	Controls.	Date of First Vaccination	Dose.
A	150	150	4/9/35	5 c.c.
B	530	530	5/9/35	5 c.c
C .. .	212	212	6/9/35	5 c.c.
D .	190	150	6/9/35	5 c.c.
E . .	288	310	7/9/35	5 c c
Total ..	1,370	1,352	..	..

For the purposes of vaccination, on each occasion the ewes were run into a race, packed fairly firmly, but not crushed in any way. The wool was parted just behind the shoulder blade and the site of injection swabbed with methylated spirits. The skin in the area was then raised and the needle of the hypodermic syringe inserted and the requisite dose given subcutaneously. Afterwards the vaccinated ewe was marked on the head with paint.

Just under three weeks after the first, the second vaccination was done. The particulars are shown in Table II.

Table II.

Farm.	Ewes vaccinated.	Controls.	Date of Second Vaccination.	Dose.
A	..	..	..	..
B	527	530	24/9/35	10 c.c.
C	198	212	25/9/35	10 c.c.
D	190	150	23/9/35	10 c.c.
E	285	310	25/9/35	10 c.c.
Totals ..	1,190	1,202	..	..

The second vaccination was not carried out on Farm A, as the ewes had commenced to lamb by this time, and under the circumstances the owner did not feel inclined to yard and draft for vaccination.

Subsequently the work consisted of keeping observations on the vaccinated ewes and controls and checking up the lamb mortality. A few colostrum samples and blood samples from lambs were collected and sent to the Veterinary Laboratory at Wallaceville for testing as to the presence of antitoxin. By the middle of December the losses of lambs which could be attributed to pulpy kidney had ceased. The relation of deaths of lambs in the vaccinated-ewe group as against those in the control group are shown in Table III.

Table III.

Farm.	Vaccinated Ewes.	Lamb Deaths from Pulpy Kidney.	Control Ewes.	Lamb Deaths from Pulpy Kidney.
B	527	1	530	24
C*	198	..	212	..
D†	190	Nil	150	8
E	285	1‡	310	35

* Six or seven lambs were lost in this lot, but, owing to the ewes leaving the dead lambs, it was not possible to identify the lambs with either vaccinated or control ewes, except in one case where a lamb from a control ewe was definitely identified.

† On this farm it must be mentioned that the control ewes were not running with the vaccinated ewes, but were under similar conditions in an adjoining paddock.

‡ This lamb died the morning after docking, and there is some doubt as to whether the actual cause of death was pulpy kidney.

If both farms C and D are excluded, and the lamb which died among the vaccinated group on farm E is counted as a definite case of pulpy kidney, we have the following result :—

812 vaccinated ewes—Pulpy kidney losses among lambs, 2 = 0·24 per cent.

840 control ewes—Pulpy kidney losses among lambs, 59 = 7·02 per cent.

DISCUSSION.

The above figures give rather striking results, and there is no doubt that the field evidence in the 1935 season fully justifies the trials and gives most encouraging support to the possibility of successful vaccination of the ewes with a vaccine prepared from *Clostridium welchii*, type D. It certainly appears that a considerable degree of immunity is conferred on the lamb through the colostrum of the mother, and a further extension of this experimental work is warranted next season, on an extended scale if possible.

The farmers chiefly concerned are enthusiastic regarding the success of vaccination, and are prepared to have further trials carried out.

The laboratory examination of the colostrum and blood of lambs from vaccinated ewes would indicate the presence of antitoxin. Owing to various circumstances this work was not carried to its ultimate conclusion, but as far as it went the results obtained were definite, and

suggest strongly that some protection was afforded. Dr. Hopkirk, Officer in Charge, Veterinary Laboratory, furnishes the following report :—

" Tests against mice were made as follows :—

" (1) Five colostrum samples from vaccinated ewes : Mice protected by 0·015 c.c. of whey in three cases, and by 0·02 c.c. in two cases. The three lambs' sera from these ewes have not been tested.

" (2) Ten lambs' sera from vaccinated ewes : Mice protected by 0·015 c.c. in six cases ; by 0·02 c.c. in one case ; by 0·025 c.c. in one case, by 0·1 c.c. in one case, and not protected by 0·5 c.c. in one case. Colostrum from the dams of these lambs not taken.

" (3) 0·015 c.c. whey from ewe's colostrum taken before birth protected mice ; milk after birth not taken ; 0·02 c.c. serum from lamb out of this ewe protected mice.

" There were no samples of normal unvaccinated lambs' or ewes' sera sent up for control tests, but two normal ewes' bloods here gave no protection whatever against the toxin."

CONCLUSION.

A method of protecting lambs from deaths due to pulpy kidney which has given encouraging results is indicated. It is practical and economical in application.

Certain acknowledgments are due in connection with this work to D. A. Gill, M.R.C.V.S., D.V.S.M., for the suggestion that the trials be carried out ; to Dr. Hopkirk for the preparation of the vaccine and tests for antitoxin ; to A. L. Thompson, M.R.C.V.S., for carrying out the vaccination work ; to J. Fleming, Inspector of Stock, Ranfurly, for field arrangements ; and finally to those farmers in Central Otago who willingly co-operated with us.

CARE NECESSARY IN USE OF WORM-DRENCH FOR SHEEP.

PRECAUTIONS TO BE TAKEN IN PREPARING COPPER SULPHATE (BLUESTONE) AND NICOTINE SULPHATE DRENCH.

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IN spite of the long period over which copper sulphate has been used for the drenching of sheep and lambs, there still appears to be a great deal of misunderstanding about the size of the dose, and often an almost criminal carelessness in the weighing of the material and the measurement of the water. Cases of its improper use, particularly with regard to miscalculation of the dose, have frequently come to notice. Few farmers freely admit doing something wrong, but the misfortunes resulting from the misuse of a particular treatment soon become known and tend to bring discredit upon a drug which, if used properly, has only beneficial effects.

There is nothing to be gained by starving prior to drenching. In fact, the chances of an accident are much reduced if the animals are

drenched as soon as possible after being brought into the yards. For many years it has been the custom for farmers to hold their sheep and lambs off feed for twelve hours or so before drenching, but recent experiments have shown conclusively that results are quite as good if this preliminary period of starvation is omitted altogether. The sheep may be brought in and drenched as soon as they have settled down, and not only is this much more convenient for the farmer but also is far less of a strain on the sheep

As a routine practice, lambs should be first dosed at weaning and dosed at least monthly thereafter. In seasons such as the present one, when worm-infestation is likely to be especially troublesome, dosing at intervals of about sixteen days is desirable. Apart from its use as a destroyer of parasites in the stomach and bowels, copper sulphate has a distinct tonic effect if given in proper doses.

The copper sulphate should be clean and bright, and should be mixed in a porcelain, enamel, or wooden vessel, and not used until thoroughly dissolved. Boiling water should be used in preference to cold when mixing.

One pound of copper sulphate to 5 gallons of water is the stock solution now recommended, with the addition of 16 fluid ounces of commercial 40-per-cent. nicotine sulphate. One half-ounce of this contains between 4 gr. and 5 gr. of copper sulphate, and is a sufficiently large dose for a lamb of from four to seven months old. For sheep of from eight to twelve months the dose may be increased up to 1 oz., depending upon the size and general health, and grown sheep should be given 1½ oz.

The mixture has a particularly astringent action upon the membranes about the throat, so care should be taken not to hurry the dosing, or some of the material may go into the breathing passages.

A mortality which occurred in recent months amongst lambs drenched with bluestone may be quoted in illustration of the necessity for accurate dosing. The lambs were held over-night and dosed during the following morning. The solution used contained 3 oz. to the gallon; and 1 oz. to 2 oz. of the material were given. These lambs were about five months old, and the amount of copper sulphate that each received was from 9 gr. to 18 gr. Some of the lambs were noticed to be ill within a few minutes, and died within two hours. The mortality was really quite a heavy one. A number recovered, but only after some weeks.

COMPARISON OF GROWTH IN SEXED AND IN UNSEXED PULLETS.

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THE purpose of the trial recorded herein was to ascertain the difference in growth, if any, during the first six weeks between sexed pullets when reared separately and pullets when reared in the usual way (unsexed) with cockerels. The chickens used in this test were hatched on the 17th September, 1935, and 274 (unsexed) chickens were placed under

an electric brooder. They were weighed before being put under the brooder, and were thereafter weighed when seven, fourteen, and twenty-eight days old, and the pullets only on the forty-second day after being hatched. (See Table No. III.)

The chickens were fed on a dry-mash mixture, which was before them all the time. (Table I.) At 5 p.m. they were fed a little scratch grain, as shown in Table I, to encourage them to work, but it was noticed that they never at any time appeared ravenous for this grain. After the fourth day a mixture of young green oats and silver beet, finely cut up, was fed separately between meal-hours at 9 a.m., 2 p.m., and after the last meal at 5 p.m. Skim-milk and also water were given them to drink from the start. Fine oyster-shell grit was always before them in an open hopper—this allowed them to consume as much as they required.

Thus it will be seen that this lot was treated in exactly the same manner as the sexed pullets were treated in pen 2 of the trial which was described in the April issue of this *Journal*, wherein detailed information about the feed consumed by the sexed pullets is given.

The mash and grain mixture were made up as follows :—

Table I.

Mash.	Grain-mixture.
40 lb. ground maize (maize-meal).	75 lb. (3 parts broken wheat).
20 lb. bran.	25 lb. (1 part broken maize).
14 lb. pollard.	
10 lb. ground oats (not oat-meal).	

After the first week approximately 3 per cent. of meat-meal and 3 per cent. of bone-dust were included in the mash.

Table II gives details of the amount of food consumed, the cost of the food, and also the total of food consumed for six weeks ; but as some of the cockerels were taken out of the pen after twenty-eight days and some were kept for further use it is not possible to compute the average cost of rearing the 126 pullets for six weeks. As mentioned at the outset, the object of the test was to see if any difference in the growth developed during the first six weeks between sexed and unsexed pullets.

Table II

Foodstuff.	Price.	Amount consumed.		Cost.		
		lb.	oz.	£	s.	d.
Maize-meal	9s. per 100 lb.	226	0	1	0	4·08
Bran	7s. per 100 lb	113	0	0	7	10·92
Pollard	6s 6d per 100 lb. ..	81	0	0	5	3·18
Ground oats ..	15s per 100 lb.	50	0	0	7	6
Meat-meal	8s. per hundredweight ..	15	7	0	1	1·232
Bone-dust	12s. per hundredweight ..	14	12	0	1	6·964
Wheat	5s. 7d. per bushel (60 lb.)	42	0	0	3	10·9
Maize (kibbled) ..	5s. per bushel (50 lb.) ..	14	0	0	1	4·8
				£2	9	0·076

The following are the details of the number and weights of chickens, and also days of weighing :—

Number.	Age.	Weight.		Average Weight.
MIXED OR UNSEXED CHICKENS.				
	Days.	lb.	oz.	oz.
274 chickens	1	25	3¼	1·47
269 "	7	33	11	2·01
263 "	14	52	14¼	3·22
261 "	28	117	7	7·14
126 pullets	42	81	13½	10·39
SEXED PULLETS.				
	Days.	lb.	oz.	oz.
102 pullets	1	8	8	1·33
98 "	14	20	13	3·39
98 "	21	30	10¾	5·01
96 "	28	44	10¾	7·44
96 "	42	76	3	12·66

The above figures show that the one-day-old mixed chickens averaged 1·47 oz. as against 1·33 oz. for the sexed pullets, which would indicate that day-old cockerels are slightly heavier than day-old pullets.

At six weeks old the pullets which had been reared with cockerels only averaged 10·39 oz. as against 12·66 oz. for the sexed pullets, thus showing that the sexed pullets grew more rapidly when reared by themselves.

Both lots of chickens were from the same parent stock.

The 274 chickens had the use of one brooder, while the 102 sexed pullets had the use of one-half of a brooder of similar size and type.

FARMING IN THE AUCKLAND PROVINCE.

OBSERVATIONS ON FARM-MANAGEMENT METHODS.

P. W. SMALLFIELD, Fields Superintendent, Auckland.

V. THE CENTRAL PLATEAU AND THE WESTERN UPLAND.

THE Central Volcanic Plateau forms the main watershed of the North Island; commencing south of Lake Taupo, it stretches across the North Island from the main mountain-range on the east to the high elevated marine plain on the west, and extends northwards as far as the Bay of Plenty. Relatively flat over wide areas, the plateau rises here and there into high volcanic cones, flat-topped hills, and serrated ridges. Rhyolite lava-flows and large masses of pumicestone form the tableland, and the numerous volcanic cones that occur throughout its extent are built up of rhyolite, andesite, and partly also of basalt. Lake Taupo is everywhere surrounded with volcanic rocks which form a high tableland from 2,000 ft. to 2,200 ft above the level of the sea and upon which numerous volcanic cones arise. The Waikato River leaves Lake Taupo at the north-east end and shapes its course north-east for a distance of about twenty miles, flowing through a broad terraced valley on the boundary of the Kaingaroa Plain. After its junction

with the Waiotapu River the Waikato makes a sharp turn to the west, flows through a mountainous region in a deep gorge, and emerges near Maungatautari in the broad plain of the Middle Waikato Basin. The Mokau rises on the flanks of the Hauhungaroa Range and flows to the west coast, entering the sea about half-way between Kawhia Harbour and New Plymouth. The Waipa has its source upon the Rangitoto Range and joins the Waikato at Ngaruawahia. The Wanganui River rises on the Central Plateau at the foot of Mount Tongariro, and the

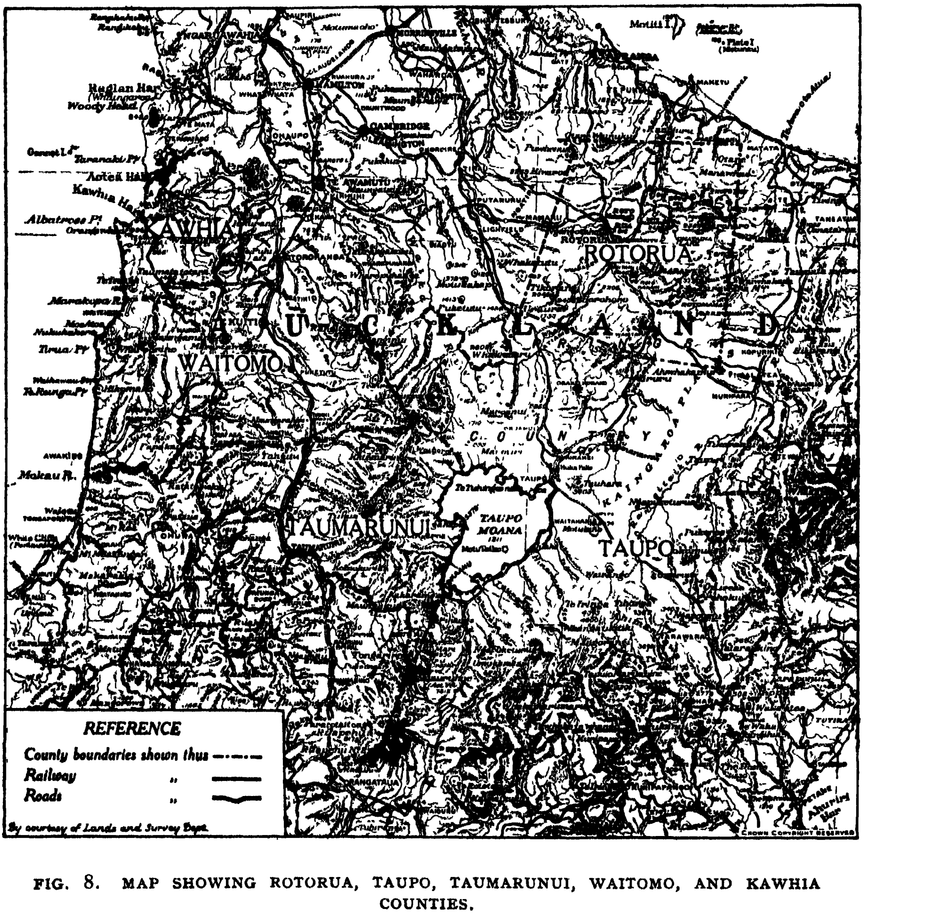

FIG. 8. MAP SHOWING ROTORUA, TAUPO, TAUMARUNUI, WAITOMO, AND KAWHIA COUNTIES.

Rangitaiki River, which enters the sea between Whakatane and Matata, rises in the mountains to the east of Lake Taupo and flows along the edge of the Kaingaroa Plain.

The Western Upland is a continuation of the coastal ranges of South Auckland, and consists of a broad and deeply dissected plateau, based on beds of greywacke, conglomerates, limestones, and claystones, covered in parts and sometimes to considerable depths by an accumulation of rhyolite tuff and breccia, the product of eruptions in the Taupo district. In the west only the finest dust was deposited, and this has

formed the brown sandy-loam soil characteristic of large parts of the area. The Western Upland is divided from the Rangitoto and Hauhungaroa Ranges on the edge of the Central Plateau by a depression running north and south, which is about eight miles wide at Te Kuiti and widens in the south to eleven miles opposite Okahukura. The northern end of the depression is drained by the Waipa. The Mokau, after crossing the depression, flows in a southerly direction and five miles south of Pio Pio the river drops over the Wairere Falls and enters the Totoro Gorge, which is nine miles in length and 100 ft. to 200 ft. deep; several miles below the Wairere Falls the river receives the Mokauiti; the little Mokau, its principal tributary from the left. Three large branches of the Wanganui River drain the southern part of the district—the Ongarue, the Ohura, and the Tangarakau.

Generally the climate is mild and humid; the mean annual rainfall is about 50 in., but on the elevated areas of the west the rainfall increases to 80 in. to 100 in. On the Central Plateau the winters are cold, unseasonable frosts occur, and snow falls on the mountains in the winter.

Originally most of the country was heavily forested, but on the pumice plains of the Central Plateau occurred large areas of open tussock grassland, on which, since the invasion of rabbits and the occurrence of fires, the vegetation over large areas has changed to manuka and manoao scrub. The heavily forested areas of the Western Upland were settled early in the present century on the completion of the Main Trunk Railway. The bush was felled, burnt, and the land grassed; but settlement has not prospered on certain areas. The rainfall is heavy, many of the soils are composed of light volcanic ash and require phosphatic top-dressing, and a good deal of surface-sown grassland has deteriorated and reverted to second growth of fern and manuka. Blame for reversion has been attached to the type of grass mixture originally sown, which usually consisted of rye-grass, cocksfoot, and clovers; as soon as the initial high fertility derived from the ashes of the burn fell, white clover went out and was followed by rye-grass and cocksfoot, the carrying-capacity fell, and the bare ground was occupied by fern and manuka. The grass-mixture for a bush burn on this type of land should provide for a temporary high fertility in an extremely available form, a medley of soil types, a strong volunteer weed growth, and an ultimate reduction of fertility over all the area. A suitable mixture consists of perennial rye-grass, 12 lb.; Italian rye-grass, 4 lb.; cocksfoot, 8 lb.; crested dogstail, 3 lb.; *Poa pratensis*, 1 lb.; brown-top, 1½ lb.; *Danthonia pilosa*, 3 lb.; white clover, 2 lb.; *Lotus major*, 1 lb.(22). The Italian rye, perennial rye, and cocksfoot provide feed during the early years all over the burn, and the perennial rye, cocksfoot, and white clover remain where the fertility is kept high, whilst the danthonia and brown-top come in as fertility falls, make a complete turf, and help to prevent deterioration. The use of a sound seed-mixture is only the foundation in the battle against secondary growth; crushing with stock, clearing up logs, and resowing all have to be carried out if secondary growth is to be controlled. "No seed mixture, however, that could possibly be devised in itself will control secondary growth. The predisposition of this class of country under review to run to forest is too strong, and these secondary-growth associations must be recognized as stepping-stones back to

forest. Natural grassland associations are possible without man's assistance only where scrub land or forest land is impossible owing to climate. The act of felling and burning the forest does not alter one whit the urge of the country to afforest itself. It simply sets back the successional development, or converts what one may term a stable climax association into one of flux, with all the inherent vigour of youth and opportunities for development according to the habitat conditions meted out "(23).

Settlers were helped to some extent in checking deterioration by the Deteriorated Lands Act, 1925: "An Act to make Provision for the Relief of the Occupiers of certain Crown and other Lands in respect of Hardships due to Deterioration of such Lands or to their Natural Lack of Productivity." Revaluation committees were set up under the Act, with power to revalue the land and to recommend remission of rent or interest, consolidate and reclassify farms, and recommend advances and define the purposes for which advances should be made. Here are two reports of the revaluation committees:—

(1) "Farm of 1,129 acres, of which 1,100 acres of bush land have been felled and grassed and consist of 600 acres reverted to fern and 500 acres of poor pasture and 29 acres of standing bush; the farm carries 400 ewes, 200 dry sheep, and 70 cattle; the carrying-capacity could be increased a little with top-dressing and should show better returns, but unless it is top-dressed the carrying-capacity will decline still further."

(2) "Farm of 800 acres, of which 230 acres are in fair pasture, 328 acres second growth and fern, and 242 acres standing bush; carrying-capacity, 450 ewes and 20 cattle; a very poor section, and one on which an enormous amount of money has been lost; there are only 230 acres of the section worth farming, the balance is all poor hills with cliffs and bluffs; it is all running back to fern and second growth. Carrying-capacity on the whole will decrease and cannot be improved. If the 230 acres of the farm near the road could be kept clean and top-dressed it would carry stock for an indefinite period, but the remainder of the section is not worth trying to save."

Pasture deterioration consisted of two phases—first, the lowering of fertility and consequent deterioration of the pasture sward; and, secondly, the invasion of second growth—bracken fern, hard fern, water fern, manuka, and piripiri (hutiwai). Management methods to control deterioration consist of fencing and crushing with stock, logging-up, cutting manuka, resowing after manuka and bracken-fern burns, and top-dressing. To be effective, top-dressing requires the presence of clovers in the pasture—if clovers are absent or present only to a very limited extent, improvement by top-dressing is very slow. The first application to poor hill pastures slightly increases the clover content of the pastures, gives a somewhat better colour to the grass, and may improve the thriftiness of the live-stock; the second application leads to a further improvement in the clover content, consequent improvement in growth of grass, and improved carrying-capacity. For a start, top-dressing should be confined to the best grassland and used to assist in the establishment of secondary sowings on manuka and bracken-fern burns. Top-dressing must be carried out on a systematic plan and accompanied by an increase in stocking if the additional feed produced is to be made use of.

A good deal of improvement was effected by top-dressing, but most of this was lost during the depression years, when low wool and stock prices made the practice uneconomic. Secondary sowings following manuka burns for the establishment of danthonia, brown-top, and dogstail also proved satisfactory; but again the depression years held up improvement along these lines. At the present time some deteriorated Crown sections are being improved by the Small Farms Board; where the land is ploughable the areas are being cleared, ploughed, and resown for dairy-farming, and the new pastures sown down are to be maintained by top-dressing.

*Table VII.—Crops and Live-stock: Table showing Areas in Crops and Pasture and Numbers of Live-stock in the Central Plateau and Western Upland Counties, 1933–34 Season.**

County.	Crops.			Live-stock.			
	Annual Crops.	Pasture.	Pasture cut for Hay and Silage.	Dairy Cows.	Other Cattle.	Sheep Shorn.	Pigs
	Acres.	Acres.	Acres.				
Kawhia ..	544	79,237	471	6,013	16,740	64,105	1,793
Waitomo ..	5,216	274,577	4,717	21,409	54,976	281,085	7,287
Rotorua ..	2,778	61,305	4,550	10,998	11,786	28,645	4,663
Taumarunui ..	1,675	99,527	1,747	5,793	15,754	117,067	2,261
Taupo ..	1,114	28,072	1,342	2,568	4,336	7,193	930
	11,327	542,718	12,827	46,781	103,592	498,095	16,934

* From Agricultural and Pastoral statistics

Farming consists in grazing Romney sheep and beef cattle on the surface-sown hill country, and dairy-farming and fat-lamb raising on the undulating hills and flat land in river-valleys and on lake-shores. Much of the pumice country on the Central Plateau is naturally unhealthy for sheep and cattle; the complaint experienced is known as "bush sickness," and occurs chiefly on areas of wind-borne pumice ash, areas of water-borne pumice being generally free from the complaint. Bush sickness for many years hindered settlement of pumice land on the Central Plateau, but it is now satisfactorily treated with limonite licks for cattle and sheep(24)

TAUMARUNUI COUNTY.

May 13th, 1935: Lake Taupo, Tokaanu to Kuratau Stream.—"The name Taupo," remarked Hochstetter, "reminds me of one of the grandest natural sceneries I have ever seen." The great lake, the numerous volcanic cones, the snow-clad Kaimanawa Mountains, and the great open pumice plains, practically untouched by settlement, is a sight ever to be remembered. A fine sunny autumn day, and the launch trip across the edge of the lake, past Waahi and Pukawa Villages, to the Kuratau landing was very pleasant. The west shore of the lake is formed of vertical cliffs of rock, which, near Karangahape, reach a height of more than 1,000 ft. above the level of the lake, and landing is only possible in a few places. At the mouth of the Kuratau Stream Maoris were busy digging their potato crops. Here is cropping-land that has been used by the Natives for centuries; when exhausted with cropping, it is allowed to grow weeds until it recovers, and fresh

patches are taken for cropping. The soil consists of 12 in. of a dark, free-working sandy loam on a subsoil of weathered pumice silt. One could not help thinking what an improvement the use of good potato-seed, red clover, and superphosphate would bring about in the potato-culture. Up on the terraces of the river the soils are sandy and overlie a coarse, sandy subsoil containing a good deal of river shingle. Passed over the hills towards Mount Pukekikiori, and the level of the plateau is here 1,400 ft. to 1,600 ft., but on the return to Waahi the height is 1,900 ft. in places. Here on the western side of Lake Taupo is a great open tableland originally a great tussock plain, but now largely covered in manuka, fern, and manoao, with tussock only in the colder hollows. Up to a few years ago the Maoris ran sheep on this plain, but, with the rest of the tussock grazing-areas round Taupo, this has now been abandoned. On the south of the plain are bush-clad mountains (Kakaramea, 4,259 ft.), and away to the west the high bush-clad mountains of the Hauhungaroa Range, beyond which lies Taumarunui; to the north can be seen Mount Tauhara (3,603 ft.), where the Waikato leaves Lake Taupo, and in the distance the peak of Titiraupenga (3,383 ft.) and the wooded ridges of the Rangitoto Range. This great open pumice plain on the west of Lake Taupo contains a considerable area of potential farming-land, but at present there is no farming in the eastern part of Taumarunui County.

October 29th, 1935: Waimiha to Taumarunui.—The terraces of the Waimiha River are here about 800 ft. above sea-level, and at Waimiha there is a Native-land settlement block which has recently been developed. At this time of year the pastures look remarkably well, having a strong growth of white and red clover, cocksfoot, and rye-grass. Originally these pumice flats were in short manuka, manoao, and tussock: the land was ploughed and sown in permanent grass. Subsequent management has developed two types of pasture: where establishment, grazing, and top-dressing have been good, pastures of rye-grass, cocksfoot, and white clover have been established, whilst where the initial establishment was poor, or a red-clover smother occurred, the pastures consist of cocksfoot and red and white clover. It is only the first type of pasture that is profitable—a cocksfoot, red and white clover pasture throws no winter or early spring feed and is very difficult to manage. Further, this type of pasture is liable to degenerate to danthonia, sweet vernal, and suckling clover if close-grazed during the winter. The road and railway from Waimiha to Taumarunui follow the valley of the Ongarue River, which joins the Wanganui River at Taumarunui. The land consists of pumice terraces in the river-valleys, rising to steep manuka and fern-clad hills. Areas of the lower hill country were once grassed, but have now reverted to manuka. Originally the steep hillsides were clothed in strong bracken fern and tutu, and the initial establishment of a pasture was fairly easy. The fern was burnt and grass and clover seed sown in the ashes of the burn. Red clover established well, provided plenty of feed, and the fern was crushed out, but after the red clover disappeared from the pastures carrying-capacity declined, and fern and manuka came in. The soils of the pumice hills require regular top-dressing if good pastures are to be maintained. Many of the developed dairy-farms on the flats show a good deal of ragwort in the pastures, and sheep are really necessary on this country to control the weed. The chief pasture areas of Taumarunui County

consist of surface-sown bush land on which are grazed Romney sheep and beef cattle; for the 1933–34 season there were 117,067 sheep shorn and 63,767 lambs tailed in the county.

TAUPO COUNTY.

May 9th, 1935: Tokaanu.—Visited Hautu and Rangipo Prison Farms. All this country was once an open tussock plain, but rabbits and fires converted it into scrub lands. At Otukou Pa (Kaitieke County) near Lake Roto Aira there are still the wool-shed and sheep-yards remaining from the days when a considerable number of half-bred sheep were grazed over these plains. Prior to development, the flats at Hautu and Rangipo were in heavy manuka and the hills in fern and tutu. It is good healthy pumice country, and the river-flats contain a good deal of greywacke shingle brought down by streams from the Kaimanawa Mountains. Some of the grassing at the prison farms was done before supplies of certified perennial rye-grass seed were available, and pastures sown with short-lived strains of rye-grass show interesting features. Without perennial rye-grass these pumice hills cannot be satisfactorily grassed: short-lived strains of rye-grass go out and leave cocksfoot and white clover, which makes a fair pasture only if it is top-dressed and not heavily grazed in the winter. At Rangipo, where cattle-fattening is the main industry, these pastures have stood quite well, but at Hautu, where breeding ewes and cows are carried, some of these swards have deteriorated to danthonia. A cocksfoot-white-clover pasture will not stand hard winter grazing: rye-grass is absolutely necessary and rye-grass-white-clover-cocksfoot pastures can be maintained only if they are regularly top-dressed.

May 16th, 1935: Tokaanu to Reporoa.—The eastern shore of Lake Taupo is flat, and is composed of great banks of pumicestone sloping down to a sand-beach, and beyond the pumice plains and hills extend back to the Kaimanawa Ranges; at the north-east end of the lake the great Kaingaroa plains extend north-east as far as Murupara; once a great plain of tussock-grass, the area is now almost completely planted in pine forests. Between Taupo and Rotorua there is a depression in the general level of the Central Plateau, whilst the main level of the plateau is about 2,000 ft., much of the land in the depressed area—roughly the land lying between the two roads from Rotorua to Taupo—is from 1,000 ft. to 1,600 ft. in elevation, but right across the middle of the area lies the Paeroa Range, and numerous volcanic cones occur through its extent. The road from Wairakei to Reporoa crosses over great terraces of pumice sand, across the bend of the Waikato River, which first flows north-east on the margin of the Kaingaroa Plain and then turns west at its junction with the Waiotapu River. All this great stretch of pumice hills and terraces is now being planted in pine forests. Pioneer settlers were attracted to settle in the Waiotapu River Valley, near its junction with the Waikato River, by the existence of considerable areas of flax-swamps: from the swamps development spread to the open pumice plains. After the war, returned soldiers were settled on the Reporoa Estate, and, more recently, further land on Mr. Earle Vaile's Broadlands Estate has been developed for settlement under the small-farm plan.

(To be continued.)

THE DAIRY SUPPLIERS REGULATIONS, 1936.

By clause 55 of the Dairy-produce General Regulations, 1933, a supplier who during any manufacturing-season delivers his supply of milk or cream to a cheese-factory, creamery, or skimming-station must not transfer his supply during the same season to any other cheese-factory, creamery, or skimming-station unless he obtains the consent of the owner or manager of the manufacturing dairy to which his supply is being delivered. A supplier is at liberty, however, to transfer his supply without consent where the owner of the manufacturing dairy to which his supply is being delivered ceases to carry on the business of purchasing milk or cream or for any reason refuses to continue to purchase supplies from any particular supplier.

By the Dairy Suppliers Regulations, 1936, the right of a supplier to transfer his supply on the grounds mentioned shall not apply where during any manufacturing-season a purchase or merger of existing interests has been effected by owners of dairy factories with a view to the elimination of competition for supplies. In any such case suppliers to the factory of the vendor whose premises have been closed down must deliver their supplies to the purchaser for the remainder of the season. Where owners of dairy factories have agreed upon a voluntary zoning-system with a view to eliminating overlapping in the cartage of supplies, any supplier affected by the agreement must deliver his supply for the remainder of the season to such one of the owners, being parties to the agreement, as is nominated by notice served on the supplier.

—*A. E. Morrison.*

SEED-WHEAT CERTIFICATION.

CERTIFIED CROPS.

UNDER the Government scheme for the certification of seed-wheat, the following growers have seed from crops which have passed both field and grain inspections. (Previous lists, to which purchasers are also referred, were published in the March and April issues of the *Journal*.)

Variety.	Grower.	Acreage.
Cross 7	*Armstrong, F G , Tycho, R M.D , Timaru	15
	*Canterbury Seed Co., Leeston	10
	*Coughlan, M., Kingsdown, Timaru ..	11
	*Dickson, A. M., St Andrews	7
	*Grant, A., Waimate	20
	McLeod, P. N., Sutherlands R D , Pleasant Point	19
	*McMaster, H , Cave, South Canterbury	10
	*Mulholland, W. W., Darfield	10
	Selbie, G., Claremont, Timaru ..	9
	*Wolff, R. G., R.M.D., Rangiora-Bennetts	25
Dreadnought ..	*Cooper, W., Kakanui, North Otago ..	52
	Corrigan, J., Linkwood, Hook ..	10
	Coughlan, M., Kingsdown, Timaru ..	14
	*Evans, H., Section 6, Kauru Hill R D	29
	Gray, G , Uritane, Waimate	20
	*Manson, D. J., Enfield, Oamaru ..	12
	*Morrison, J. L., Morven	19
	*Newlands, G., Kauru Hill R.D. ..	31
	*Stevenson, W. S , Incholme R.D ..	11
Hunters II ..	*Bowie, J H., Otaio, South Canterbury ..	20
	Campbell, J., Albury, South Canterbury	20
Solid Straw Tuscan	*Blank, E. C., St. Andrews	5
	*Casey, J., Claremont, Timaru ..	10
	Craig, A., Greenfield, South Otago ..	9
	Davey, A J., Waitohi, Temuka ..	7
	*Frewn Bros., Waimate	4
	Jones, J., Waiwera South	26
	Robinson, J., Springfield Road, Milton ..	10
	Tutton, F A , Springston, R.M D ..	8

* Passed subject to machine-dressing of seed.

—*Fields Division.*

SEASONAL NOTES.

THE FARM.

General Pasture Work.

IN many districts pastures, especially ones containing a substantial amount of well-nourished rye-grass, when closed towards the end of May or in early June, provide valuable fresh feed in late July and August. The amount of July-August feed obtainable in this way may be increased by the use of manures containing nitrogen such as ammoniated superphosphate or sulphate of ammonia. The results from nitrogenous fertilizing are best when phosphates are applied just shortly before or at the same time as the nitrogenous material: the results from nitrogenous material used alone are likely to be disappointing. On soils which are known to respond to lime, liming should be associated with the use of sulphate of ammonia. Further, in certain cases where no visible benefit follows the use of lime either alone or in conjunction with phosphates liming has been found to beget better results from sulphate of ammonia. Because of this, even when there is doubt whether liming as a general practice is economic, it is, as a rule, in the absence of definite evidence to the contrary, advisable to lime when using sulphate of ammonia either by itself or in the form of ammoniated superphosphate. Whether the use of nitrogenous manure in this manner proves profitable depends on a number of circumstances, such as the type of pasture, the gravity of the need of the additional feed, the cost of alternative supplies of additional feed, &c. Hence no general recommendation about the advisability or otherwise of using nitrogenous fertilizer can be made.

Certain pastures are more suitable than others for providing late winter and early-spring feed. These are the ones which are well drained, which contain a considerable amount of rye-grass, and which possibly also are provided with shelter. A special endeavour should be made to harrow and top-dress such pastures in good time, as the additional early feed thereby obtained is likely to be specially valuable.

Almost invariably harrowing of dairy pasture is not carried out often enough to secure the fullest fertilizing effect from animal excreta. Possibly more attention would be given to this matter were it realized that in a year the excreta of a cow of 1,000 lb. live-weight, giving 350 lb. of butterfat, have been estimated to contain the equivalent of about one standard-size sack of 44 per cent. superphosphate, 7 cwt. of sulphate of ammonia, 1 cwt. of carbonate of lime, and 3 cwt. to 4 cwt. of 30 per cent. potash salt. If droppings remain long undisturbed there occurs not merely waste of much of this potential fertility, but positive harm from it. Such waste and harm can be avoided only by harrowing frequently enough. The point of direct importance is that, to many farmers who possess both harrows and the power to draw them, more frequent harrowing will not involve more direct outlay, but it will lead to a feed-supply of greater size and of better quality.

If at this stage any pastures are showing evidence of infestation of grass-grub, then when possible hay, roots, and silage should be fed out on them: the grubs seem to suffer from the resultant additional treading. A certain amount of resowing may occur from seeds contained in the hay and thereby bring about thickening of swards weakened by destruction of plants, and consolidation of the soil appears to facilitate the replacement of the parts of roots damaged by the grubs.

Pre-winter Top-dressing.

Any top-dressing that still remains to be done before the spring should be done as soon as possible: the special advantage of pre-winter top-dressing is to some extent lost if it is done when the soil is so cold that pastures have practically ceased growth until the arrival of spring conditions. Because the date of commencement of this cold period varies according to location, it is impossible to give guidance generally applicable, but as a rule no avoidable delay in top-dressing should now take place.

Although, if it is at all possible, top-dressing should be carried out before the advent of the most inactive period of pasture-growth, it may be advisable at times to top-dress during this period as an alternative to the inconvenience, and, possibly, inefficiency, resulting from an unduly heavy rush of work in the spring. The effect of phosphatic manures applied when the pastures are practically dormant is delayed as distinct from lost. The same is held to be true in general of lime and of potassic manures. But it is different with soluble nitrogenous manures: if conditions unfavourable to growth prevail for any considerable time after the application of such manures the value of the benefit obtainable from them, judging from considerable field experience, is substantially lessened.

Generally it is not advisable to apply soon after each other lime in any of its forms and any of that group of chemically similar phosphates which includes raw rock phosphates, Island phosphates, and African phosphates. These phosphates are all relatively slow in their action, and become more markedly so when used on land which has received lime. Liming carried out in close proximity to the application of basic slag may be expected to reduce the speed of action of the slag. When lime and phosphates are to be applied separately in the same season it may be taken as a general rule that it is preferable to do the liming first.

Farm Drainage.

In general, winter proves the most suitable season in which to attend to farm drainage. A point of prime importance that sometimes seems to be overlooked is that outlay readily may be wasted at least partially on drainage—even on that of land requiring draining—unless the work is planned and carried out in a careful manner. In planning a drainage system the first matter that should be determined is the source of the excessive supply of water. The determination of this may indicate the possibility of adopting the less costly course of draining an area by preventing water reaching it instead of by removing water after it has reached the area. Wet areas along hillsides or at foothills often offer opportunity for the use of drains placed to intercept water in the passage to badly drained land. As a rule, the first few pounds spent on drainage return the greatest percentage of profit: hence there is no justification for putting off drainage improvement of an area until a complete drainage system can be provided. Often the drainage of wet spots in a field is the most profitable drainage work a farmer can undertake. This is particularly true of land used for arable crops. In the drainage of isolated wet spots, especially if tile drains are being installed, an endeavour should be made to locate the drain-lines in such a way that they may serve as part of any more comprehensive future work, and probably be the basis of it.

Apart from low-lying water-logged soils which obviously are in a badly drained condition there are in many parts of New Zealand heavy retentive soils which would give quite profitable returns from judicious outlay on drainage. Mole drainage, because of the comparatively low cost, will be utilized with profit in the future over much greater areas than any other form of drainage. In many areas a firm clayey subsoil occurs just below the surface soil. Land of this formation is well suited for mole drainage

Formation of Mole Drains.

Only brief mention of matters at times dealt with inefficiently is here possible: detailed information may be obtained from local officers of the Fields Division.

The formation of mole drains is usually best done in early winter after the first heavy rains have well moistened the subsoil. If the subsoil is too dry when the mole-plough passes through it, the walls of the drain may be cracked, and this is likely to lead to eventual premature failure of the drain: on the other hand, if the subsoil is too wet, a glazed wall on the mole drain may result, and this is considered to bring about slower passage of the water from the soil into the drain. Further, to mole drain early in the winter is at times advantageous because the considerable amount of wet weather that follows as a rule results in closing of the slits made by the blade of the mole-plough. Instances are on record in which drains were rendered quite useless when a period of dry weather occurred relatively soon after the somewhat late drawing of the drains: in the dry weather the slits made by the blade of the mole-plough cracked open, the soil crumbled and fell into the drain and silting-up ensued.

Mole drains up to 8 to 10 chains long as a rule give good service, and they may safely be made somewhat longer, provided there is a good and uniform fall throughout their length. Mole drains are not suited for use on extremely level ground, but they work satisfactorily when there is a fall of 3 in. to 4 in. to 100 ft., and so it is seldom necessary to rule them out on account of lack of fall. It is not advisable to establish mole drains on a steep grade, for too rapid flow of water causes the sides of the drain to scour away, and this may readily lead eventually to the collapse of the drain. It is particularly advisable to avoid in mole drains level sections or depressions, which bring the danger of gradual silting and eventual blocking of the drains. Hence, since the fall of the drain follows the contour of the surface of the land, it is advisable to go round instead of across depressions.

The drawing of mole drains should be done at a slow steady speed. The more quickly the plug of the mole-plough passes through the subsoil the more likely it is to break the walls of the drain, which hastens crumbling. The use of a powerful tractor may result in the carrying-out of the work at too great a speed—what is an excessive speed depends to some extent on the type and the condition of the subsoil—it is reported that particularly poor results have followed speeds of 3½ to 4 miles an hour.

Mole drains usually are placed at a depth of 17 in. to 20 in. The top of the drains should be about 2 in. in the subsoil: if the drains are not below the more open relatively crumbly surface layer their period of service will be greatly reduced. On the other hand, they should not be placed more deeply than ensures avoidance of the comparatively crumbly surface soil: the deeper they are in the retentive subsoil the slower will be drainage—a distinct disadvantage. It is important to keep in mind that the depth of mole drains should be determined not by the average thickness of the more open surface layer, but by its greatest thickness: if this were overlooked the mole drain would collapse, after a relatively short time, in those parts of it that passed through surface soil where the layer of it happened to be deepest. Any such collapse would render a part at least of the drainage system ineffective.

The distance between the mole drains is to some extent a matter of choice: in practice it is seldom if ever less than is profitable, while often the drains are too far apart for fully economic service. The heavier the texture of the land the closer should be the drains. Usually it is not advisable to place mole drains farther apart than 9 ft., and often better and more profitable results would be obtained from drains 6 ft. apart on the more tenacious clays.

Like other drains, mole drains do not work properly unless they are kept open at the mouth. Mole drains may discharge—(1) along a natural hillside or terrace, (2) into open drains through firm subsoil, (3) into intercepting tile drains, (4) into intercepting larger mole drains, which serve as main drains. When mole drains discharge along a hillside or terrace, the openings often are in soil or crumbly subsoil, which usually provides a very inadequate outlet unless proper measures are adopted. One means of dealing with this position is to dig a trench at the mouth of each mole drain until solid subsoil is reached and then to lay tiles from this point to the point of original discharge and fill in the trench. It is not satisfactory merely to lay a tile or two at the opening in the subsoil and to have the mole discharging into an open trench, for the latter is likely to become blocked by the treading of stock When the mole drains discharge through firm subsoil into open drains, it is necessary simply to attend at suitable intervals to the removal from the mouths of the mole drains of material apt to hinder discharge. When discharge of mole drains is to be carried away by intercepting tile drains, the tiles should be placed at a depth which would allow the mouths of the mole drains to discharge at the same level as the top of the tiles. It is preferable to form the mole drains before the trenches for the tile drains have been opened, but the opening-up of the trenches for the tiles should be carried out as soon as possible after the drawing of the mole drains By avoiding delay in this respect one eliminates the danger of material collecting in the mole drain in the vicinity of where it crosses the tile drain When the intercepting tiles are being laid, it is advisable to establish a connection between the mole and the tiles by suitably placing a grass-sod against the side of the open trench immediately above the mouth of the mole and across to the tile When a larger intercepting mole drain serves as a main drain, the main should be drawn first, otherwise in drawing the main the blade of the mole-plough will close up the mouths of the smaller intercepted mole drains The intercepting larger mole drain should be at such a depth that while it is below the others it connects with them When the smaller mole drains just break the top of the larger intercepting mole drain, the junctions have proved satisfactory Sometimes, however, it is found necessary to pierce the ground at the junction or to open up the junctions to obtain a free passage from the smaller drains into the main mole drain. Sometimes obstructions occur in mole drains They originate most commonly in " hard-pans " in the ground The plough either rises and rides over the " pans " or it penetrates them and produces rubbly material which does not give a permanent passage for the movement of water They may also originate in sandy " pockets " in the subsoil In either case the location of the trouble is indicated when the water " wells up " to the surface at the point where the drain is blocked, and the correct practice is to open up and tile carefully the affected section of the drain so as to obtain a continuous passage.

Crop Utilization.

On many farms the pulling and storing of mangels should be carried out in June, especially if the mangel area is required for another crop, such as oats, to be sown soon. But rules about the pulling of mangels cannot be laid down for general application : in some milder districts mangels continue increasing in weight beyond the date at which they cease growth in other districts. It is doubtful whether it is advisable to pull the mangels in these milder districts early in June if they are not to be used until late August or September unless the land they occupy is especially required for some other crop, or likely to become so wet later that it will be difficult to cart the crop. However, if the crop is to be fed to stock earlier than has been mentioned above it should be pulled in good time to allow it to ripen or mature before the stock consume it. Freshly pulled mangels are more subject to frost injury than those still in the ground and those that have been pulled for a few days, and so, if at all possible, broken weather should be selected for pulling.

Many sheep-farmers successfully utilize mangels relatively late in the season without storing them: broken-mouthed ewes are put in to eat off the tops, then the roots are harrowed out in breaks some days prior to the sheep being given access to them. If the mangels are to be pitted, the practice of throwing the roots into small heaps, covering the heaps with leaves removed from the roots, and leaving them for a few days before carting is favoured by some who hold that roots left in such heaps for upwards of a week before carting keep better.

The winter-feeding of stock wholly or almost so on roots is undesirable: stock so fed receive a diet which is badly balanced, too watery, and too cold. Heavy root-feeding is especially unsuitable for old toothless ewes if the roots are offered intact. Heavy root-feeding to any type of breeding-ewes, to dairy cattle, or to pigs has definite weaknesses. Roots may be supplemented suitably with dry fodder such as hay or chaff for cattle and sheep, and with grain or meal for pigs. The quantities of each class of feed to use depend to a considerable extent on various circumstances, such as the feeds available and the amount of "keep" the stock can obtain from pastures. Detailed information relative to specific cases may be obtained from district officers of the Department of Agriculture.

Guidance as to the feeding of silage is provided in the fact that 1 lb. of typical silage equals in feeding-value approximately 2 lb. of roots, and 2 lb. to 2½ lb. of silage is equal in feeding-value to 1 lb. of average good hay. This generalization is subject to the qualification that the materials differ somewhat in their suitability for specific purposes—*e.g.*, roots well can be recommended for pigs, whereas silage normally cannot. Probably the commonest mistake in the feeding of silage originates in attributing to it a feeding-value much greater than that which it actually has, with the result that stock suffer, not from any undesirable or harmful characteristic of the silage as some unwarrantably have assumed, but from semi-starvation, just as they would upon a half-ration of hay or grass. Under New Zealand conditions it seldom should be necessary to attempt to feed to dairy cows more than 40 lb. of silage daily—up to approximately 100 lb. daily has been fed with success—and usually less than 40 lb. will suffice in conjunction with the feed provided by the pastures. Silage has been fed with good results to sheep, when used to supplement pastures, at the rate of about 2 lb. daily.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Pruning Operations.

WITH the commencement of winter, a start may be made with the pruning, taking the different classes of fruits in their order of leaf-fall. As stone-fruit trees usually lose their foliage before pip-fruits, it is the practice to commence the winter pruning on these.

It is impracticable in these notes to set out detailed instructions on pruning which would be applicable to all districts and which would suit the conditions of all trees. It is necessary for the pruner to have a grasp of the main fundamental principles governing the production of healthy foliage, extension of growth, and fruiting wood. Provided these are kept in mind, the detailed application may be varied to suit local conditions.

Herein notes about the treatment of stone-fruits are given, and in next month's notes the pruning of pip-fruits will be dealt with.

The mature tree should be strong and have sturdy leaders and fruiting arms, which should be well spaced to permit of the free circulation of air and the penetration of the sunlight so needful in the development of healthy buds and young growth, and for the ripening and colouring of the fruit.

With well-spaced leaders and fruiting arms, the spraying of the tree is also rendered much easier and more thorough, with a consequent better control of diseases and pests.

With young trees the paramount aim is to secure vigorous well-built trees which will be capable in future years of carrying heavy crops. The development of the framework and fruiting arms must receive first consideration. If the trees are weakly they should not be permitted to carry fruit until they become reasonably vigorous. In some instances it is time enough to start fruiting them when the building of the framework has been completed.

The leaders should be selected early, and the number of leaders to select varies with the fancy of the grower. There are some growers who contend that three leaders are sufficient, and others who fancy from sixteen to twenty. The danger of having a large number of leaders is that of overcrowding and producing a dense mass of foliage to the detriment of fruiting

Where stone-fruit trees are planted on good soil, they are as a general rule very vigorous growers. It is the practice of some to hard-prune these vigorous young trees by cutting the leaders well back. Such hard cutting of the leaders promotes a profuse mass of growth the following summer, causing overcrowding, and, in consequence, the non-maturing of a large number of the young shoots, unless summer pruning is resorted to. During the following winter a large number of heavy rank growths produced have to be cut away because they are not of any use and are competing with the leaders Where such hard pruning is practised each winter, a great deal of waste growth is produced each year with no benefit.

Once the leaders have been selected, it is preferable, providing that growth is vigorous, to leave the leaders uncut, shortening back any side-shoots on this last annual extension of the leaders and thinning out the balance of the young growth By this method the energy of the tree is absorbed by the leaders, which respond with further extension of the growth, and at the same time greatly increase the circumference of the limbs and branches A larger and stronger tree is built up in a shorter time by this method than by hard cutting, as the growth of the tree is fully utilized and not lost in the production of waste growth

Peaches and Nectarines.—The fruiting habits of the peach and nectarine are identical The crop is produced entirely on one-year-old wood, and a heavy thinning-out is necessary each winter in order to maintain a constant supply of fruit-bearing wood. Unless an abundance of good vigorous shoots is being produced each year, the tree may be considered to be in an unthrifty condition, and to require added attention from the manurial and cultivation standpoint to maintain its vigour

All dead and diseased wood should be removed, as also all unmatured laterals in the centre of the tree. All unbranched light two-year-old laterals should be cut away, and the remaining one-year laterals thinned out to prevent overcrowding. It is generally advisable not to shorten the one-year growths—either leave them uncut for fruiting or remove them entirely. It is preferable to leave the well-ripened stocky laterals rather than the slender shoots.

The main aim should be to remove sufficient of the wood each winter to maintain the required amount of growth the following season, and also to keep the fruiting wood well spaced throughout the tree

Apricots.—The bulk of the fruit of the apricot is carried on relatively short-lived spurs. The treatment should be such as to cause the continual renewal of the fruit-spur system. Each winter fairly heavy thinning of the spurs is desirable to maintain sufficient vigour in the tree, and also to prevent overcropping.

Cherries.—The fruit is carried on long-lived spurs A better class of fruit, however, is produced if a gradual renewal of these spurs is encouraged. To accomplish this, from 10 per cent. to 15 per cent. of the fruiting wood should be renewed each year.

European Plums.—The fruit of the plum is mainly carried on short spurs and laterals of two years and older. The treatment suggested is the gradual removal of the older spurs and laterals and their replacement with younger fruiting wood. Approximately 20 per cent. of the fruiting wood should be renewed each season.

Japanese Plums.—These plums are generally prolific bearers, the fruit being borne on laterals produced during the past season, as well as on short spurs and laterals of two years and over. The finer class of fruit is carried on the wood of from two to four years of age, and the treatment suggested is the renewal of 25 per cent. of the fruiting wood each year. Fruiting laterals should be encouraged, and the annual growth left uncut where required for fruiting, otherwise it should be removed altogether. Because of the tendency of this plant to overcrop, the clusters of spurs should be well thinned out.

All prunings should be gathered and destroyed, and not left lying around.

—*R. G. Hamilton, Orchard Instructor, Hamilton.*

Citrus Notes.

Should much rain occur during the month of April, the possibility of frost injury to young growth should not be overlooked. In those parts of the district where frosts are likely to be experienced, measures should be taken by growers to protect their trees.

Wet weather at this period favours the development of brown-rot. To prevent the spread of this disease all branches should be removed to a height of at least 3 ft. from the ground and all infected fruit destroyed, while the ground beneath the trees should be kept cultivated, so as to maintain a somewhat dry soil-mulch, as fructifications of brown-rot are produced only when the soil is sufficiently moist. The spores of dry-rot develop on the surface of the soil, and may be splashed on to the tree by rain. The maintaining of a cover crop about the trees is recommended as a means of preventing this.

The time for the harvesting of citrus fruits is approaching. Lemons are best gathered when they are green or silver, and have attained a size of 2¼ in. to 2½ in. in diameter, so that they may pack from 150 to 200 per bushel case.

Poorman oranges should not be gathered until they have become " tree-ripened," unless required for the purpose of making marmalade. The best method to follow is to divide the harvesting-season into two, the early (April to July) picking being used for marmalade, while the pectin (the jelly-making material) content of the fruit is at its maximum ; and those remaining left until later for use as a breakfast fruit or for juice purposes. This fruit through being left on the tree until fully matured has become very popular in recent years.

Sweet oranges should be allowed to mature on the tree so that they may develop their full flavour and sweetness. It is only in this way that the local-grown sweet orange will be appreciated by the consuming public.

The greatest care must be exercised in handling citrus fruits in order to avoid injury, as it is through the damaged cells that the spores of various organisms which cause fruit-rots gain an entry to the tissues of the fruits. It is mainly through injuries caused in handling that such a heavy annual percentage of wastage occurs. Every one who handles fruit should make a special effort to handle it more carefully than they have done previously. If this were done it would help considerably in the marketing problems which confront the industry.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Overhaul of Plant.

As the present time is what might be termed the poultry-keeper's "slack" period, it affords an opportunity to give the whole plant a good overhaul, so that everything may be in good order for the coming busy season.

Repairs to fences, gates, nests, feed-troughs, perches, &c., should be given attention. In fact, if a prompt and regular system of repairs were adopted on all plants, the heavy expense of replacement would often be saved. Many poultry-runs would be much improved by ploughing or digging and the sowing of a green crop such as oats, barley, or mustard. If a run is at all tainted, and it is not convenient to turn it over, it is a wise plan to give the ground a good dressing of lime to the extent of about 1 lb. of lime to each square yard. Some poultry-keepers fail to realize how much improvement birds show when on fresh sweet ground. No farmer would expect his sheep to do well if kept in the same paddock year after year, yet poultry are often compelled to live in the same small yard long after the ground has become tainted and fowl-sick.

When erecting a poultry-house, it is advisable, if possible, to provide for two runs, so that they may be used alternately and sweetened regularly. If this were done, such trouble as worm-infestation and other troubles attributable to stale ground would not be so prevalent.

Some Ailments.

A correspondent inquires about the cause of pullets breaking down and at times bleeding to death.

This trouble is what is known as protrusion or prolapse of the oviduct, and is really due to a weakness of the muscular portions of the walls of the oviduct, which makes the oviduct unable to stand the strain of great egg-production At times it would appear that this weakness is inherited, as plants have been visited where pullets bred from certain males have shown a marked tendency to this trouble. Also it may be brought on by feeding too much animal food, such as meat, meat-meal, or milk, and on occasions the bleeding is caused by other hens pecking at the oviduct just when a hen is in the act of laying. This often brings on a hæmorrhage, and then the other hens in the flock will also pick at the bleeding part. If such is the case, it is well to darken the nests by tacking scrim or sacking in front of the nests, or make the nests so deep that the oviduct of the bird cannot be seen or picked at when laying. When this trouble first starts in a flock it is advisable to keep a close watch on the birds for an hour or so during the morning, and often the culprit may be seen walking along the front of the nests waiting for a chance to pick at other birds when laying. If these birds are detected and removed from the flock, further trouble may be checked

While protrusion of the oviduct is often brought on by the feeding of too much animal food, cases of cannibalism have been known to have been caused by pullets not being fed sufficient animal food. It is well, therefore, when this trouble starts in a flock, to make every effort to find the cause and to remedy the conditions. A regular supply of succulent green feed, the feeding of a little more grain and less mash, the addition of one packet of Epsom salts to each gallon of drinking-water every second day until the trouble is checked, and the increasing of the amount of litter in order to encourage exercise, is a suggested treatment.

Egg-eating Habit.

Most hens will greedily eat eggs if any get broken, and this annoying habit is often the result of eating a thin-shelled egg that has been broken

when laid on the ground or in a nest which has not had sufficient nesting material in it. At times a male bird has been known to start the trouble, and where such is the case he should be removed from the pen. Experiments have proved that hens will lay just as many eggs when running without male birds, so unless the eggs are required for hatching purposes there is no necessity to keep male birds.

Like many bad habits, egg-eating is more easily prevented than cured. A sufficient number of nests should be provided—*i.e.*, one nest to each four or five hens, and plenty of nesting material such as fine sand, *Pinus insignis* sawdust, pine-needles, or soft straw should be used. A cure has sometimes been effected by supplying the birds with a number of nearly whole fresh egg-shells. If a local baker is asked to save, say, a half kerosene-tin full of fresh egg-shells, and these are placed near the nests, the hens may eat so many that their appetites for eggs may be destroyed.

Double-yolked Eggs.

These are caused by two yolks entering the membrane-secreting portion of the oviduct, or egg-tube, at the same time. This ailment is more common when pullets are starting to lay, and some birds have a tendency to produce such eggs. The trouble is not so frequently observed in older birds.

If a number of double-yolked eggs are produced by a flock, it would indicate overfeeding, especially with meat, meat-meal, or condiments, and slight adjustments to the ration should be made. However, if only one or two birds are producing such eggs, it is not advisable to make any change in feeding methods, but if the particular bird or birds can be detected and given a dose of Epsom salts (about one-third of a teaspoonful dissolved in water), it should correct matters.

Soft- and Thin-shelled Eggs.

This trouble is usually more noticeable towards the end of a heavy laying-season, when the egg-laying system of birds is becoming more or less exhausted. The immediate cause is the failure of the shell-forming portion of the oviduct, or egg-tube, to function properly. Soft-shelled eggs are at times dropped as the result of birds being chased or frightened. The feeding of too much animal food or condiments has a tendency to cause this trouble. As the want of shell-forming material is at times a contributing factor, it is advisable to see that a plentiful supply of oyster-shell grit is always within reach of the birds. The addition of 1 per cent. of oyster-shell dust to the mash will sometimes improve matters. Finely broken-up burnt bone placed where the birds can help themselves is useful.

Simple overfeeding will cause the production of poor-shelled or badly shaped eggs, and as a remedy more exercise should be given by increasing the amount of litter, thus making the stock work for their grain However, if a large number of thin-shelled eggs is being produced, it would indicate that the constitution of the strain is going back, and perhaps some fresh blood is required.

Blood Spots in Eggs.

On occasions small spots of blood or blood streaks are found in fresh eggs. When such spots are found in the yolks it is the result of a rupture of a small blood-vessel in the ovaries, and if found in the white it is usually due to trouble in the oviduct. Perfectly healthy hens will at times produce such eggs, especially if fed rather too much animal food during the spring of the year. These troubles are usually more common during the spring at the peak period of the laying-season, when spices or somewhat too much animal food is being fed. As a remedy it is well to slightly reduce the supply of animal food during September, October, and November,

and if condiments are being fed it is advisable to discontinue their use, as they often cause irritation. The addition of a little Epsom salts to the drinking-water, about two tablespoonfuls to each gallon, should have a good effect.

The only way to prevent such eggs from being exposed for sale is to test or candle all eggs before sending them to market.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Winter Precautions.

BEFORE the cold weather sets in every hive should be examined in order to make sure that the frames are completely covered with sufficient dry, well-fitting mats to keep the bees protected Wherever a damp or mouldy mat is discovered it should be replaced with a dry one, and the roof examined and repaired. No draughts should be allowed around the frames. Mats made of corn-sacks cut to the exact size of a zinc queen-excluder answer all requirements of warmth. Care should be taken to ensure that they are placed in their exact position If placed crookedly the edges are apt to be pushed out between the hive-body and the roof, and when this occurs they in time absorb enough moisture to make them damp and unwholesome

Once more the time approaches when the necessity for shelter should impress itself on the beekeeper It is most essential that the bees be protected from cold winds during the winter. Should no permanent shelter be available, something temporary should be erected if the bees are expected to prove in normal condition in the spring. Manuka-scrub is excellent for making a temporary wind-break.

Weeds and grass should be kept down. A good clearing round the hives in autumn suffices until spring, and adds materially to the comfort of the bees and the well-being of the hives. Not only should the entrances be cleared, but the ground all round the hives similarly treated, and the weeds raked up and destroyed.

Care of Hives.

At no other season is the welfare of the hives of such importance as during the next few months. Every hive should be raised from the ground to the height of one brick, and if the situation is damp or low-lying it is a good plan to raise the hives still more This tends to keep them free from slaters (wood-lice) and other insects, affords less harbour for mice, and ensures that the hives have a free current of air beneath the bottom-boards and are thus more likely to keep dry. The bottom-boards should not rest on the ground, where they rot in very short time and become mouldy and evil-smelling

Before bad weather sets in it is a good plan to give a coat of paint wherever it is needed, at the same time stopping up all cracks in the supers Cracks afford ventilation during the summer months, but they are hardly to be advocated on that account, because the beekeeper will usually find that towards the end of the honey-flow the bees will use much valuable time in gathering propolis to paste up the cracks in view of the approach of winter. The hives should be slightly canted forward, so that any rain which falls on them may drain off the alighting-board.

Apart from disease, there is no worse feature in an apiary than the presence of leaky hive-covers. A roof which allows moisture to trickle through is a constant menace to the colony it appears to shelter. Not only will the mats immediately beneath it become sodden and mouldy, but the cluster of

bees in the hive stands in danger of extermination when frost sets in. There is no excuse for leaky covers. In the autumn the apiarist should examine them for any weak spots, and should cover them with zinc, ruberoid, or some other water-proof material. If economy must be practised, he may cover with cheesecloth, applying to the roof first a coat of paint, then the cheesecloth, and then another coat of paint. This makes an effective water-proofing, and one which anybody can apply.

Plans for next Season.

During the off-season is the best time to make plans for the following season. The beekeeper should decide what increase he desires to make, and should prepare accordingly. Making up hives and frames is exasperating work if left till the bees are badly in need of room, and it should be finished long before the actual time for increasing one's stock arrives. The beekeeper should also face the question of providing himself with stocks of foundation, and make arrangements for the treatment of his surplus wax by some neighbouring maker of foundation. He should also decide on which market to place his crop, and lay his plans accordingly. It is advisable, too, that he consider the theoretical side of his occupation, and, while the bees are in a dormant condition, study the best methods of improving his stocks. Neither weather conditions, locality, nor any other factor influences the honey crop so much as strong colonies of bees, and the apiarist should endeavour, while he has the time, to ensure these during the following summer.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Soil Fertility.

THE successful production of vegetables, or other herbaceous crops, and small fruits depends chiefly on the selection of suitable land and climate; providing what shelter and drainage may be necessary; and, after preparing the land by cultivation and manuring, planting seeds or plants of the best available varieties and strains.

Soil and climatic conditions required by the various crops differ so widely that any land of fair to good quality that is easily ploughable will produce these commercial crops of one kind or another if the problem of transport to markets is satisfactory. The limit then is market demand, which is best maintained by regular supplies, evenly distributed. In many instances, in the opinion of some authorities, the demand may be greatly extended by presenting the goods in a more convenient manner and judiciously advertising them.

The type of land which is heavy, acid, and lacking humus is fairly common, and in preparing it for horticultural crops it requires deep cultivation at intervals, probably every third or fourth year, by double ploughing in such a way that the topsoil, which is the more fertile, is not buried. To obtain the desirable friable state and to retain moisture, in addition to supplying plant-foods, farm manure or green cover-crops are ploughed under and a dressing of finely ground limestone, carbonate of lime, is broadcasted and harrowed in. To obtain the best results the limestone should be finely ground, so that the greater part of it at least will pass through a sieve with sixty meshes to the linear inch. In the absence of local data it may be applied at a rate of 1 ton to 2 tons per acre, or ½ lb. to 1 lb. to the square yard. Where land of this class has been brought to a fairly friable condition an annual dressing of ½ ton to the acre, say, ¼ lb. to the square yard,

suffices. To provide the necessary phosphates finely ground bonedust, 2 oz. to 4 oz. per square yard, may be ploughed under, or finely ground basic slag or rock phosphate may be used at the same rate.

This preparation should be done as early as possible in winter, when the land is in a comparatively dry condition. For supplies of nitrogen during the spring and summer sulphate of ammonia is the most suitable fertilizer on land of this class. Where further supplies of available phosphates are required during the growing-season, superphosphate may be used in moderate quantities. For most of the crops under consideration these fertilizers can be used on this land with best advantage only when the lime requirement has been supplied.

Other types of land of which there are considerable areas under horticultural crops are the light volcanic soils and more or less light alluvial soils. These are usually well drained and, when sheltered, are often suitable for early cropping. They are more easily managed, but, owing to oxidization and leaching, the consumption of manures and fertilizers is rapid and the land is sometimes spoken of as being more or less " hungry." The method of feeding crops on these soils is one that may be described as " little and often," especially as regards the more soluble fertilizers. Because of their friable nature early and deep cultivation in winter is not necessary, and, owing to the rapid disintegration of manures, is not desirable Also, the demand for lime is not the same as in the case of the heavy soils, where it is required for its physical action of flocculating the clay particles to get rid of the tendency to form clods and surface crust. What such open soils chiefly require are generous supplies of humus turned in shortly before cropping and a good, well-distributed water-supply. A careful watch should also be kept to see that the crops on such soils do not suffer from want of potash, of which the form known as muriate of potash is often most suitable for this type of land ; and nitrogenous top-dressings during the growing-season may consist of small periodical applications of nitrate of soda or finely ground fowl manure. Owing to the rapid consumption of fibre and humus under a system of heavy commercial cropping of these soils, the rotation should include a period at regular intervals when the land is sown down in grass and clover, and grazed.

Vegetable Crops.

Root crops, onions, &c., in storage should be examined occasionally to note their condition. Any sign of approaching deterioration should be dealt with immediately, either by adjusting the storage conditions to make them more favourable or expediting the distribution of the crop on the market

The preparation of the land for early crops and such permanent crops as seakale, asparagus, and rhubarb should now be given every attention.

A commencement now may be made to raise tomato-plants for planting out under glass, and, somewhat later, half-hardy plants of different kinds for planting outside in early summer. These are usually raised on a hotbed formed of fresh stable manure in an active state of fermentation. This state is obtained by placing the manure in a compact heap, and, when fermentation is active, restacking the material, taking care to place that on the surface in the interior of the new stack, shaking out any matted portions, and watering with a fine spray any portions that are dry. In a few days, when active fermentation is again established, this treatment is repeated. Further turnings are given as required until the whole mass is in a uniform state of active fermentation, when the hotbeds may be made in a dry place that is well drained and sheltered. At the end of the season the manure is in a thoroughly decayed state and is in excellent condition for a potting compost or top-dressing for lawns.

Good reports are being received regarding the use of electric soil-heating cables in places where stable manure is not available for making hotbeds. The cable is composed of resistance wire, insulated with asbestos, lead-covered, and wrapped with tape, which prevents corrosion by chemical action. A 50-yard cable loaded at 700 watts usually is sufficient for a six-light frame, and with a thermostat the requisite heat can be maintained economically. For a single frame a 10-yard 200-watt self-regulating cable may be obtained: this maintains a temperature of 50°, 60°, or 70° F., as desired. As this cable is self-regulating, no thermostat is necessary.

The usual method recommended for establishing outdoors a bed heated in this manner is to remove the soil to a depth of 15 in., extending 1 ft. all round beyond the frame. Fill in with 8 in. of breeze or cinders for drainage and insulation, place the frame in position, and fill round the frame with the insulating material. Lay 1 in. of sand over the drainage inside the frame, and then place the cable in position. A further 1 in. of sand is laid over the cable and then covered with 1 in. wire netting to protect the cable. On top of this 6 in. or 8 in. of soil are laid for planting, or the ordinary seed-boxes may be used in its place. Considerable economy in power used will be obtained by insulating the sides of the frame and covering the lights on cold nights, also by choosing a warm, well-drained position. In an experiment carried out where cinders were not available for insulation, a sandy loam was used in its place with promising results. The cables mentioned above should have a life of at least five years.

The Pruning-season.

Pruning was dealt with in last month's notes in so far as it had to do with planting out young trees and shrubs, with a view to laying a foundation for the rapid development of a strong plant of a desirable design. Other phases of the operation of pruning are summer pruning, which not only has much to do with the shaping of the plant, but has considerable influence in restraining growth, which is a result sometimes desired when plants are over-inclined to run to wood when flowers and fruit are desired. Hedge-trimming and topiary work are a feature in some styles of gardening, also the removal of wood so soon as it has fruited in summer, as in the case of raspberries and loganberries, &c., which not only materially assists in controlling disease, but allows the new wood, which will fruit the following year, to ripen well. The dormant period, as the winter is sometimes called, is, however, the pruning-season in a special sense, as it is then that general pruning is done on most kinds of trees and shrubs that are highly trained, such as fruit-trees, bush fruits, roses, &c., as well as shelter and shade trees which may have been damaged or which for some other reason may require attention of this kind.

The pruning of fruit-trees is dealt with in the Orchard Notes of this *Journal*. Good pruning is generally done when one keeps in view two things—namely, the habits of the plant and the object in view. Roses and hydrangeas produce their blooms on new wood of the same season. Such new wood is best produced on strong, ripe growth of the past season. Such growth should be retained and shortened. If too much is retained the plant will become crowded with new wood, and the blooms will be small. Any growth which is not retained for producing bloom next season should be cut away completely. If sufficient strong ripe wood of last season's growth is not available weaker growth is retained, cut hard back, and nitrogenous manures are given.

Black currants and gooseberries produce their best fruit on young wood of last season's growth; accordingly the best of the wood of that type is retained in each bush. The wood which fruited last season if cut away now to a bud at the base will produce young wood which will fruit in its

turn. If anxiety for a big crop leads one to retain too much fruiting wood, the results then are small fruit, many scratches when picking in the case of gooseberries, and poor growth for future cropping. The art of all good pruning lies chiefly in thinning out the growth and shortening it back to just the right extent. Other shrubs, such as the red currant, bear flowers and fruit on spurs and small laterals. Such types should be well thinned out so that the leading growth on which the spurs and laterals are borne will have plenty of light and air so as to keep them in a healthy, fruitful condition. Thinning out the wood in these plants usually takes the form of removing completely many of the strong shoots formed during the last growing-season, more especially from the centre. Shelter-trees and shrubs generally, after the initial pruning at planting-time, require little attention of this kind: usually it consists of restraining those inclined to overgrow the position, repairing storm damage, or checking any tendency to abnormal growth. While the amount of work of this kind required may be small, it is of great importance in retaining effective shelter, developing the best qualities in a shrubbery border, and preserving valuable specimen trees. Among the more important features of the treatments are to cut the limb away flush at its point of origin, or just beyond a side growth or healthy bud, make a clean smooth cut at the right angle, and give all large cuts a good coating of tar or thick paint, which should be renewed annually as required.

—*W. C. Hyde, Horticulturist, Wellington.*

SPROUTED WHEAT FOR SEED.

I. D. Blair, Canterbury Agricultural College, Lincoln.

The abnormally heavy rainfall throughout Canterbury early in the year caused severe sprouting of wheat standing in the stook, and even in the standing crop.

At the beginning of this new growing-season many farmers are concerned about the value of sprouted lines of wheat for seed purposes, and the problem is being investigated, but the complete results are not yet available. The following is some progress information for the benefit of the farmers who are sowing now.

A sample of sprouted grain was examined and the sprouted grains sorted into four classes, from the most severely sprouted—viz., all with green shoots over ½ in. long—to the least sprouted, where the shoot had just broken through. Laboratory germination of such grain after air-drying and after eight weeks in stack ranged from 58 per cent to 96 per cent. When sown in the soil, however, the percentage establishment of seedlings ranged from 3½ per cent. to 45 per cent where the sprouted seed had been air-dried. Where the grain had been stacked the germination of the seed in the soil was even lower. Undoubtedly no farmer would consider sowing such badly sprouted grain as was used in these trials, and by machine-dressing an ordinary sprouted sample most of the badly sprouted grains may be separated from sound unsprouted grains.

Some commercial lines of sprouted seed have also been tested. Laboratory and field germinations were lower than unsprouted seed. However, the field germination of such commercial lines of seed varied from 80 per cent. to 88 per cent., and such seed is quite satisfactory for seed purposes, especially if a few more pounds of seed per acre than usual are sown.

These conclusions have been reached as a result of sowing the samples in early April. When the results of the May sowings are available a detailed account of the investigation will be published.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

TREATMENT OF WORMS IN CATTLE.

J. F., Towai :—

Trouble is being experienced with young stock suffering with worms. The animals affected are six-months-old to eighteen-months-old heifers and steers. Could linseed oil and turpentine suitably be used? Is it mineral or vegetable turpentine that is used? Can bluestone and mustard suitably be used for controlling worms in cattle? What quantities of the above drenches are used for young cattle?

The Live-stock Division :—

It is advisable to use bluestone and mustard rather than turpentine and oil, as the worms usually found are the small stomach worm. All stock should be drenched whenever they are weaned, and in badly affected cases treatment should be applied every month if this can be done. Dissolve 2 oz. of bluestone and 2 oz. of mustard in 1 gallon of water; use an enamel or porcelain container—do not use a metal container such as one of iron. To six-months-old cattle give 8 oz. of the solution; to eighteen-months-old cattle twice that dose. Eighteen-months-old animals are not so likely to be "wormy."

In addition, it is advisable to feed some hay, crushed oats, and bran, and allow access to rock-salt

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THROAT-TROUBLE IN FOWL.

D. M., Wanganui :—

A fowl has throat-trouble She makes a noise such as fowls do when eating wheat too quickly Her comb has gone a purple shade, and she has not laid well since she developed this trouble. She coughs more in the heat of the day than she does at night. Could you advise me what is the matter and what treatment to give?

The Live-stock Division :—

From the symptoms given, and without examining the bird, it is impossible to state with certainty what the trouble is. It may be a case of simple catarrh, bronchitis, influenza, a small tumour in the air passage, or, again, the heart may be the cause of the trouble However, it is advisable to separate it from the rest of the flock and treat as follows: Give ½ teaspoonful of Epsom salts dissolved in water. If the eyes, nostrils, or mouth are affected they should be washed with warm water containing 1 teaspoonful of common salt to the quart. The air-passage should then be disinfected with a 3-per-cent. solution of boracic acid. This can be done by injecting the solution into the nostrils with a small syringe or a medicine-dropper.

If the bird does not recover in a few days' time, you should destroy it.

METHOD OF ASSESSING LAMBING PERCENTAGE.

R. F., Oamaru :—

What is the generally recognized method of stating a lambing percentage in a case such as the following: 1,000 ewes to rams, 50 ewes die during winter, 50 ewes are dry, 900 lambs are born, 800 lambs are tailed?

The Live-stock Division :—

The method of arriving at the lambing percentage is to take the number of lambs tailed against the number of ewes put to the ram. In the case you cite, 800 lambs were tailed out of 1,000 ewes put to the ram, which is equivalent to a lambing percentage of 80.

WEATHER RECORDS: APRIL, 1936.

Dominion Meteorological Office.

NOTES FOR APRIL.

FOR the first eighteen days the weather in April was warm with an absence of wind, and, except in western and southern portions of the South Island, there was very little rain. In consequence, stock and vegetation thrived. At the end of the month there was abundance of feed available. During the first part pastures hardened considerably in most districts, and for the first time this year lambs began to fatten well. Cold, wet, and stormy weather after the 18th, however, caused a setback. The milk-yield was well maintained for the time of year, but is now falling off.

Rainfall.—The rainfall distribution was irregular. On the west coast of the South Island it was below normal, while in coastal areas between Kawhia and Foxton it was mainly above. In other districts there was much variation, some stations having more and some less than the average. The latter were somewhat the more numerous.

Temperatures.—Temperatures were considerably above normal in all districts, the departures being generally in the neighbourhood of 1·5° F. There were few frosts, and none severe Snow is rather unusually thick and low on the mountains for the time of year

Sunshine.—As regards sunshine, the reports to hand indicate rather variable conditions. In the North Island, Napier, with 208·2 hours, had a sunny month, as also did Tauranga At New Plymouth and Wellington there was rather less than the average In the South Island, Marlborough totals exceeded the average, but elsewhere the month was a cloudy one. This was particularly the case in eastern districts, where there was a prevalence of low cloud, and a number of fogs were experienced.

Pressure Systems—Until the 18th, pressure was generally high over the Dominion, and although a number of shallow depressions passed they were responsible for little rain except on the west coast of the South Island. The most active one passed on the night of the 2nd. It caused fairly widespread rain, with some heavy falls in Westland, Southern Otago, and Southland.

On the 18th a depression moved down from the north, and, crossing the Auckland Peninsula, developed a small but rather deep centre north of the Bay of Plenty on the 19th. Gales blew round the centre, but elsewhere the winds were not strong This storm continued to move southwards, and when east of the South Island it was reinforced by a series of westerly depressions which advanced across the South Tasman Sea Pressure continued to fall until the 23rd, on which day there were north-westerly gales from Cook Strait southwards, some damage being done in Canterbury. From the 19th to the 25th most places had rain every day, and there were many heavy falls, especially on the 22nd and 23rd. As the last of the series of depressions passed on the 24th and 25th, a cold snap occurred, and there were many hailstorms. Thunderstorms, also, were rather numerous during this period, and three small tornadoes were recorded, one at Tauranga and two in North Taranaki.

On the 28th a somewhat similar weather sequence set in. A shallow depression from the Tasman Sea gradually deepened, and, passing through Cook Strait, was centred east of Kaikoura on the 30th Again a series of westerly depressions moved into this centre, and with each one the pressure over New Zealand fell further. The winds fluctuated between north-west and south-west as the depressions passed, and became strong. Temperatures fell with each southerly change, and there were numerous hailstorms and much snow on the ranges. This weather sequence did not terminate until the 2nd May. Rain was general on the 29th and 30th April.

RAINFALLS FOR APRIL, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average April Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
			North Island.			
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	2·14	15	0·34	4·42	22·41	14·96
Russell	5·77	18	1·81	4·25	51·12	13·77
Whangarei	3·46	17	1·22	4·93	32·55	17·18
Auckland	2·72	15	0·60	3·88	21·36	13·69
Hamilton	5·38	12	1·07	3·85	24·52	14·09
Rotorua	4·11	11	0·94	4·41	31·13	15·91
Kawhia	5·32	9	1·10	4·65	21·44	14·48
New Plymouth ..	6·18	11	1·28	4·59	22·97	16·39
Riversdale, Inglewood ..	7·64	12	1·73	8·11	36·57	28·69
Whangamomona ..	11·46	10	2·03	6·52	29·93	20·97
Hawera	3·89	8	0·96	3·48	18·23	12·40
Tairua	5·13	20	1·27	5·96	26·96	19·51
Tauranga	4·31	16	1·32	4·70	28·38	16·43
Maraehako Station, Opotiki	5·98	10	1·78	4·74	30·42	16·43
Gisborne	2·86	11	1·22	4·05	23·51	14·65
Taupo	3·55	12	0·63	3·60	22·90	12·85
Napier	2·64	14	1·05	2·36	25·85	9·98
Hastings	2·60	13	0·93	3·33	24·51	10·27
Whakarara Station ..	4·10	11	1·10	..	30·19	..
Taihape	2·39	10	0·41	2·78	20·56	10·97
Masterton	2·67	12	0·94	3·05	20·13	11·14
Patea	4·10	10	0·68	3·67	19·82	13·01
Wanganui	3·63	10	0·74	3·27	18·65	10·99
Foxton	3·86	11	1·17	2·50	17·97	8·69
Wellington	3·33	12	0·70	3·64	21·21	12·48
			South Island.			
Westport	6·86	17	1·36	8·25	20·30	29·30
Greymouth	7·57	15	1·27	8·48	26·15	32·66
Hokitika	7·15	15	1·24	9·46	24·91	36·29
Ross	7·63	11	2·16	12·18	30·35	44·21
Arthur's Pass.. ..	11·83	13	3·25	15·42	32·65	52·63
Okuru, South Westland	11·17	9	2·62	14·12	46·18	50·52
Collingwood	..	..	..	8·15	..	25·81
Nelson	3·08	11	1·29	3·10	11·29	11·55
Spring Creek, Blenheim	4·53	10	1·18	2·12	14·33	8·50
Seddon	2·51	9	0·94	1·71	12·78	7·40
Hanmer Springs ..	2·66	10	0·94	3·37	25·18	13·84
Highfield, Waiau ..	1·90	10	0·37	2·60	20·35	11·02
Gore Bay	1·82	9	0·48	2·38	17·43	9·77
Christchurch	2·87	13	0·91	1·75	17·12	7·48
Timaru	1·11	5	0·48	1·57	15·43	7·91
Lambrook Station, Fairlie	1·43	8	0·59	1·97	13·05	8·55
Benmore Station, Clear-burn	3·13	13	0·91	2·40	7·89	9·20
Oamaru	1·04	7	0·55	1·79	13·60	7·40
Queenstown	4·20	11	1·71	3·08	11·40	10·54
Clyde	1·12	6	0·71	1·45	4·44	5·85
Dunedin	1·68	9	0·73	2·77	17·89	11·79
Wendon	3·05	6	1·90	2·71	11·65	10·91
Balclutha	1·86	6	1·08	2·19	9·28	8·80
Invercargill	2·73	17	1·32	4·24	14·03	15·31
Puysegur Point ..	8·98	18	1·61	7·67	28·69	29·00
Half-moon Bay ..	3·80	17	1·53	5·10	13·11	19·37

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INVESTIGATION OF CREAM QUALITY.

A. M. STIRLING, Manager, Morrinsville Co-operative Dairy Co., Ltd.

SYSTEMATIC investigation of grassland food-taints in milk and cream, carried out on a co-operative basis by the Dairy Research Institute, Department of Agriculture, and the Morrinsville Co-operative Dairy Co., Ltd., was commenced in September, 1934.

Levy(1) established the general causes of these food-taints in certain Waikato areas, and suggested the possibility of reducing the intensity of the flavour by modification of pasture and herd management. In addition to the botanical aspect, the investigations have disclosed a number of points of interest and importance to the dairying industry, and these form the subject-matter of the following notes.

As indicated in Levy's report, night and morning creams from some forty representative farms were subjected daily to critical examination not only for intensity of feediness of flavour of the type characteristic of the Morrinsville, Hinuera, Cambridge, Te Awamutu, and other areas, but also for any other specific flavours, as well as for relative purity from the bacteriological point of view.

On a number of occasions the flavour attributed to land-cress was noted. This flavour, however, appeared only in isolated cases, and seldom, if ever, simultaneously in both night's and morning's cream or on two or more consecutive days from the same farm. The incidence of the flavour was therefore comparatively slight in the Morrinsville area in the season under review. In one instance of pronounced land-cress flavour in cream, search at the farm revealed the presence of only a few land-cress plants around gateways and fences adjacent to the milking-shed. In contrast with this, at another farm in the same district practically all the pastures were known to be heavily infested with the plant, and numerous inspections showed that it was regularly grazed by the herd. Yet careful daily examination of the cream from this farm revealed the typical flavour on one occasion only. The evidence available is meagre, but suggests that the serious trouble which sometimes arises from this source may be traceable to individual cows or to cows in abnormal health, and perhaps to a certain stage of growth

(1) LEVY, E. B.: *N.Z. Journal of Agriculture*, Vol. 50, No. 3, March, 1935.

of the plant. Soil conditions may also have some influence, since in certain areas of New Zealand large percentages of cream are affected each year with this taint. It is well established that taint-producing foods are more potent in effect when consumed within the four-hour period prior to milking, and this, too, may be a factor in the incidence of the taint.

Flavours described as "oily" or, perhaps more correctly, as "tallowy" were noted in a few instances. These flavours were found in their truest form in creams of excellent condition and low bacterial count. Attempts to reproduce the flavour biologically failed in all cases. The addition of small amounts of ferric chloride to low-count cream of good, clean flavour produced a slightly tallowy flavour after eight hours holding and an intense tallowy flavour in twenty-two hours in samples held at room temperature. Samples held at 44° F., and samples to which copper filings had been added, produced metallic flavours less pronounced in tallowiness. Efforts to locate the seat of the trouble at the respective milking-sheds were not always successful, but there is some evidence to suggest that metallic, or mineral oil, contamination was the cause of tallowy flavour in the cream in most instances.

A flavour strongly suggestive of caustic-soda contamination, frequently noted in night cream from one shed, was found to develop with equal intensity in the morning cream if held twenty-four hours. It has been tentatively established that a specific organism is a causative agent in producing this taint, which could be reproduced in twenty-four hours in sound, clean-flavoured milk and cream by inoculation with the organism which had been isolated. In the shed mentioned above the "breather" tube connected to the releaser of the milking plant was found to be heavily infected with this organism, and the trouble disappeared from the cream immediately the tube was replaced and the air system cleaned out.

"Sweet curdling" of cream (distinct from "ropy" cream) was noted on numerous occasions. It is possible that this defect is associated with the presence of milkstone deposits in milking-machines.

Generally, it would be true to say that faults noted in the cream, apart from food-flavours, were in most instances traceable to defective conditions at the sheds, and usually to the milking plant itself. Very often, of course, there is no clear dividing-line between describable flavours and those which can only safely be termed "off" or objectionable. The degrading of cream regarding the flavour of which the grader cannot accurately apply a more precise term than "off" is, naturally, sometimes resented by the supplier. Nevertheless, the present investigations have demonstrated beyond any doubt that the grader's judgment is convincingly supported by the bacteriological condition of such creams. Indeed, if it be accepted that the evidence afforded by bacteriological examination of cream is conclusive, it must also be accepted that, although grading by the senses is seldom at fault in placing creams in a lower grade than is warranted, the senses frequently err in failing to detect the presence of defects which should result in the degrading of the cream.

In a series comprising some 6,000 separate samples of cream, critical grading by the senses classed a third of the samples as "off" or doubtful in purity. Classification by the direct-microscopic-count (Breed) method showed that 18·9 per cent. of the rejected samples gave bacterial counts of under 15,000,000 and 81·1 per cent. over 15,000,000 organisms per cubic centimetre. Records show that the lower-count creams were rejected by the senses chiefly on account of absorbed or chemical flavours. At the same time, large percentages of cream of high bacterial count were classed as "sound" in the judgment of the senses. The evidence clearly points out the limitations of the usual system of grading on the factory stage, especially in respect to cream delivered daily and early in the day, and is indicative of some of the perplexing difficulties well known to be associated with ordinary cream-grading. The position may to some extent be due to variations in the dominant types of organisms present and to fortuitous temperatures hastening or retarding the initial stages of the fermentation process. Orla-Jensen(2) points out that no appreciable amounts of decomposition products are separated in what is known as "the incubation period." The chemical changes brought about by micro-organisms are, of course, manifold. But if the desideratum is purity of the cream-supply, and if grading is to be placed on a more equitable basis, it seems evident that an advanced cream-grading test, supplementary to the senses, is urgently needed.

The presence of food-taints renders consistent grading of cream still more complex— not so much on account of the possibility of confusing "feediness" with contamination (extensive records show that, with care, this error is almost negligible) as on account of the widely varying degree of intensity of feediness and widely varying percentages of cream affected throughout the months when food-taints are prevalent. Levy's report shows how very difficult it would be to establish standards that would prove equitable in the light of present-day knowledge and circumstances ; and the extreme difficulty of complying with a rigid standard will be appreciated from the following extracts from records, covering approximately 8,000 separate samples of representative creams, examined twice daily*:—

Percentage of Creams classed as sound in Quality but "feedy" in Flavour.

Period ended	Morning Cream.	Evening Cream.
	Per Cent.	Per Cent.
9/10/34	6·0	47·0
29/10/34	57·0	86·6
29/11/34	15·3	61·9
19/12/34	2·8	16·8

(2) Dairy Bacteriology, 2nd Edition, 1931.

* All samples were examined by two or more graders, who were frequently assisted by Messrs. W. Dempster and E. Melton, of the Dairy Division. The bacteriological and other laboratory services referred to in these notes were carried out by Mr. H. W. Boucher, B.Agr.Sc., of the staff of the Morrinsville Co-operative Dairy Co., Ltd.

Food-flavour Intensities (on Scale of 0 to 100 Points) of Cream from Farms classified by Mr. E. Bruce Levy according to Pasture Types.

—	Morning Cream.		Evening Cream.	
Pasture type	1	2	1	2
	Points.	Points.	Points.	Points.
9/10/34	1·6	2·2	12·4	27·8
29/10/34	11·4	15·9	24·0	34·8
29/11/34	2·3	2·5	8·2	31·5
19/12/34	0·22	0·5	3·9	3·5

Pasture Type 1, from "heavily manured farms, heavily stocked over a period of years, resulting in a higher producing early spring sward that is dominantly perennial rye-grass and white clover."

Pasture Type 2, from farms "moderately well manured and in process of building up to a high per-acre stocking. . . . The sward is dominantly white clover with rye-grass rising sub-dominant. . . . Cocksfoot, *Poa pratensis*, and Yorkshire fog, with some sweet vernal and suckling clover in the weaker parts, are also present."

In November and December over 4,500 separate samples of morning and evening creams were examined by standard acidity tests, as well as by the senses and by direct bacterial count. The first- and the last-named tests failed to show any correlation with the judgment of the senses in respect to food-taints. This was also true in respect to direct bacterial counts made throughout the season. For comparison of the methods of cream-grading on the basis of soundness of quality—irrespective of food-taints—the standard "pass" acidity was fixed at 0·15 per cent. as lactic acid in November (the figure recommended for universal adoption by the recent Royal Commission) and at 0·2 per cent. in December. A few summarized examples of results will suffice to show that no substantial agreement was found to exist between the judgment of the senses and the standard acidity tests, or between the latter test and direct bacterial counts.

Trials were conducted at intervals in the endeavour to ascertain the value of the methylene-blue test, as applied in simple, direct form to cream, in comparison with the methods cited above. Results were unsatisfactory, and the impression formed is that considerable refinement of technique would require to be evolved before this test could be accepted as of real practical value in the grading of cream.

Experience suggests that many practical difficulties have yet to be overcome before any present-day laboratory test can be put into operation at a reasonable cost in the daily grading of factory cream-supplies. The direct-microscopic-count (Breed) method has a number of special merits that appear to place this test quite definitely in the lead at the present time. Fundamentally it affords a sound means of quickly gauging the relative purity of cream, and it probably carries greater conviction to the mind of the layman than does any other simple test. It is well adapted for use in farm-dairy instructional work, and the

extension of its use to the grading of cream would be a natural and desirable corollary. Modification of minor details may be possible and eventually lead to solution of the practical difficulties of application.

Comparison of Grading by Standard Acidity Test, Direct Microscopic Count, and by the Senses.

A + indicates that acidity of cream was above standard.
A − indicates that acidity of cream was below standard.

Period ended	Standard Acidity.	Percentage of Total Creams graded.					
		Evening Creams.			Morning Creams.		
		A+	A−	Degraded by Senses.	A+	A−	Degraded by Senses.
	Per Cent.						
19/11/34 ..	0·15	82·3	17·7	31·0	24·0	76·0	13·2
31/12/34 ..	0·20	36·4	63·6	40·9	Nil	100·0	3·3

Period ended	Graded by Acidity.	Distribution by Senses: Percentages of each Group.			
		Evening Creams.		Morning Creams.	
		Passed.	Degraded.	Passed.	Degraded.
19/11/34	A+	65·9	34·1	75·4	24·6
	A−	83·6	16·4	90·4	9·6
31/12/34	A+	33·2	66·8	Nil	Nil
	A−	73·9	26·1	96·7	3·3

Period ended	Standard Acidity.	Percentage of Total Creams graded.							
		Evening Creams.				Morning Creams.			
		A+	A−	Over 15,000,000 per Cubic Centimetre.	Under 15,000,000 per Cubic Centimetre.	A+	A−	Over 15,000,000 per Cubic Centimetre.	Under 15,000,000 per Cubic Centimetre.
	Per Cent								
19/11/34 ..	0·15	82·3	17·7	89·6	10·4	24·0	76·0	32·5	67·5
31/12/34 ..	0·20	36·4	63·6	92·9	7·1	Nil	100·0	26·0	74·0

Period ended	Graded by Acidity.	Distribution by Direct Bacterial Counts: Percentages in each Group.			
		Evening Creams.		Morning Creams.	
		Under 15,000,000 per Cubic Centimetre.	Over 15,000,000 per Cubic Centimetre.	Under 15,000.000 per Cubic Centimetre.	Over 15,000,000 per Cubic Centimetre.
19/11/34	A+	2·1	97·9	20·0	80·0
	A−	48·6	51·4	82·4	17·6
31/12/34	A+	Nil	100·0	Nil	Nil
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

FARM-SHED SURVEYS.

Extensive study has been made of those conditions at farms which most urgently need attention to improve the quality of cream delivered to factories. Special surveys carried out at large numbers of representative milking-sheds have revealed many points of interest and importance and show that a very large measure of improvement is entirely feasible, in most cases without any material addition to costs. In this work special attention has been given to the collection of reliable data concerning—(*a*) The incidence of mammitis and general udder troubles: (*b*) the condition of sheds, yards, and surroundings, and of milking-machines, separators, and utensils; the facilities for washing up and sterilizing milking equipment: (*c*) attention given washing of hands, udders, &c., and the personal care exercised throughout in herd and shed management generally: (*d*) supply and temperatures of water available for cooling purposes, and the efficiency of farm cream-coolers: (*e*) the direct bacterial counts of the milk and cream at the shed, and of the same cream on arrival at the factory. Nearly all of the special surveys have been carried out on "surprise" visits. The sheds have been selected with a view to covering as wide an area as possible and ensuring that the information collected would be truly representative in all respects. The method of examining the milk for symptoms of udder trouble and the classifications adopted have been substantially the same as those used by the Live-stock Division, namely:—

Group A, normal includes milks having a body-cell count* not exceeding 1,250,000 per cubic centimetre and without characteristic mastitis bacteria.

Group B, sub-acute includes milks having from 1,250,000 to 12,000,000 body-cell count without observed mastitis bacteria.

Group C, acute includes milks having a body-cell count of over 12,000,000 per cubic centimetre with or without observed mastitis bacteria.

Samples of milk from some thousands of cows have been examined separately, and results are summarized as follows:—

Occurrence of Mammitis in Individual Cows.

Period of Investigation.	Class.	Average Percentage of Total Cows examined.
		Per Cent.
December, 1934, to April, 1935 ..	Normal	59
	Sub-acute	25
	Acute	16

Range of Percentage of each Class of Animal found in Individual Herds.

Period of Investigation.	Class.	Range.
		Per Cent.
December, 1934, to April, 1935 ..	Normal	23 to 98
	Sub-acutely infected ..	2 to 46
	Acutely infected ..	0 to 59

* All counts are made on the gravity cream layer of the milk-sample.

Excessive numbers of non-pathogenic bacteria were found in approximately 4 per cent. of the milks tested, ranging in individual herds from 0 to 55 per cent. No precise information is available regarding the full effects of the abnormality in milk as disclosed above, but it is reasonable to expect that total production would be adversely affected and that the natural balance of the constituents of milk would be more or less upset, with some degree of detriment to quality. It seems abundantly evident, however, that the control of mammitis is a problem of major importance to the industry. The regular testing of dairy herds appears to be the most reliable means of gauging the true incidence of the disease and of leading to universal adoption of control measures. The present investigations suggest that under-staffing at milking-sheds in many cases prevents adequate attention being given to the herd at milking-time.

The condition of sheds, yards, and surroundings has usually been found reasonably good. The visible condition of milking-machines, separators, and utensils has varied considerably: the most common faults were found to be dirty or perished rubberware, foul air-systems, and (especially where steamers are in use) the formation of milkstone deposits throughout the plant. The washing of hands, udders, &c., has not always been found uniform, even at the same shed, and wide variations have also been found in the methods employed and facilities provided for washing up and sterilizing the milking equipment. The general position from the quality point of view can be more accurately and concisely summed up by reference to the following figures:—

Direct Microscopic Counts on Milk and Cream, December, 1934, to April, 1935.

Sample.	Distribution on Basis of Bacterial Count			
	67 per Cent. of Total Samples with Lowest Count: Average Count per Cubic Centimetre.	Remainder: Average Count per Cubic Centimetre.	Range of Counts per Cubic Centimetre.	
			Maximum	Minimum.
Individual milkers. Hand-milking and strippings	10,000	1,200,000	60,000,000	Under 10,000
Milk in vat	333,000	5,000,000	13,000,000	10,000
Cream in cans at shed: Evening	272,000	9,000,000	60,000,000	10,000
Cream on arrival at factory	31,800,000	259,000,000	Over 500,000,000	1,000 000
Cream held in factory cool-room overnight	1,000,000	17,000,000	70,000,000	10,000
Morning cream from same sheds	1,300,000	43,000,000	Over 300,000,000	10,000

NOTE.—The counts of samples of the first of the milk drawn through the machines ranged up to 400,000,000 per cubic centimetre.

From the above figures it will be noted that in two-thirds of the special surveys a reasonably high standard of purity was found in the cream at the milking-sheds, but that exceedingly rapid bacterial development occurred overnight. It is very evident that lack of cooling of the cream was the chief factor contributing to the progressive deterioration of quality. Inadequate cooling was found to be due primarily to the capacity of the coolers being much too small in

relation to the size of the separators, and secondly to failure to make the best possible use of the fairly cool bore-water available at large numbers of sheds. The general practice of drawing water for the cooler from the outside service-tank was found to be almost useless in hot weather; and provision of a water connection direct from the pump to an efficient cooler of suitable size is usually well worth while. Water from sources other than bores was invariably found to be much too high in temperature in the summer months to permit of adequate cooling of the cream; but the percentage of sheds affected was relatively small. The following data indicate the position:—

Temperatures (December, January, and February Figures).

——	Averages.	Individual Range.
	Degrees F.	Degrees F.
Milk in vat	92	87 to 94
Cream from separator	90	86 to 92
Cream in can at finish	77	67 to 88
Water to coolers	69	61 to 77
Water from town supply or streams	74	72 to 75
Water direct from bores	61·2	59 to 64

The most striking examples of the efficacy of cooling are found in comparing the bacterial counts of samples of cream held in the cool-room overnight with the counts of samples taken from the can on the factory-stage the following day, both samples being examined at the same time. Thus original counts of under 10,000 have been found to remain under 10,000 per cubic centimetre in the samples held in the cool-room. It is recognized, of course, that equally thorough cooling and control of temperature is not yet practicable at milking-sheds. Nevertheless, allowing a difference of 3° F. between temperature of the water to the cooler and final temperature of the cream, the above figures suggest that, on the average, it should be possible in the hottest weather to cool the cream to 64° F., compared with the actual average of 77° F. recorded above. Individual losses, varying from 3° F. to 23° F., and averaging 13° F., could therefore be avoided at a minimum of cost in a great many cases. It is quite indisputable that attention to this matter alone would be of exceedingly high value to individual farmers and to the industry as a whole. It was found that a very pressing need exists for a cooler adapted for use with modern low-setting of milk vats and separators, the position of the separator cream-spout in many cases being only an inch or two above the top of a medium-size cream-can. Encouraging results have been obtained with various designs and sizes of coil coolers (constructed of tinned-copper tubing, and suspended in the cream-can), over which the cream is cooled as it flows from the separator and as it rises in the can. If the supply of cooling-water is adequate, these coolers are capable of reducing the temperature of the cream to within two or three degrees Fahrenheit of the inlet temperature of the water; and the coolers may be allowed to remain in operation after separating is finished to maintain constant temperature of the cream. In some instances installation of a small mechanical cooling-unit may be warranted; and it is expected that New Zealand manufacturers will soon be in a position to offer suitable outfits at a quite moderate cost.

In these investigations it has been observed that low initial bacterial counts apparently depend to a far greater extent upon personal standards of cleanliness and systematic attention to detail than upon the provision of elaborate facilities. Good facilities for washing up and sterilizing the milking equipment make the work much easier and certainly provide a most desirable safeguard, but the first essential is adoption of a sound routine in the cleansing of equipment. Numerous instances could be quoted to show that excellent work can be accomplished under difficult conditions, and that the personal element is very largely the determining factor in the production of sound-quality cream. Similarly, it has been found that a grave potential danger lies in the fact that in many cases the washing-up after the evening milking is of a very perfunctory nature. This may well cause quicker deterioration of the quality of the morning cream than would otherwise be the case.

Laboratory co-operation on the lines indicated above convincingly demonstrates the vital importance of (1) systematic cleanliness, and (2) thoroughly cooling the cream as it flows from the separator and of holding the cream at lowest possible temperature overnight. Laboratory work points out many unsuspected weaknesses and very often explains, in a way in which ordinary inspection quite fails to do, results that otherwise seem inexplicable. As an educational measure its merits are outstanding: it offers a feasible means of raising farm and factory instructional services to a higher and infinitely more profitable level.

As an indication of the value of laboratory assistance in farm-dairy instructional work, the following typical case is cited. The cream in question had frequently been degraded on account of what the grader could only describe as "off," "objectionable," or "unsound" flavour. Repeated inspections at the shed failed to reveal any definite cause of the trouble. The herd of eighty young cows was hand milked, and lack of cooling of the cream appeared to be the only outstanding weakness. Examination of the milk for symptoms of udder or teat trouble showed that 98 per cent. of the herd was normal, with 2 per cent. in the sub-acute mammitis class. Detailed surveys were made at the shed on the 10th and 28th of the month. Following is a summary of the results:—

DIRECT BACTERIAL COUNTS.

10th of Month.

		Counts at 20 Hours (Samples held at Room Temperatures). Per Cubic Centimetre.
(1) Milk drawn by milker A, under	10,000 per cubic centimetre	460,000
,, B, ,,	10,000 ,,	960,000
,, C, ,,	60,000 ,,	5,100,000
,, D, ,,	480,000 ,,	6,800,000
,, E, ,,	630,000 ,,	8,800,000
(2) Cream in can at shed (evening): Cooled to 80° F., 1,500,000 per cubic centimetre	.. ..	500,000,000 (Sample from can at factory)

28th of Month.

(1) Milk drawn by milker A, under	10,000 per cubic centimetre	120,000
,, C, ,,	10,000 ,,	190,000
,, D, ,,	10,000 ,,	370,000
,, E, ,,	10,000 ,,	1,240,000
,, F, ,, (taking place of "B").	180,000 ,,	6,540,000
(2) Cream in can at shed (evening): Cooled to 68° F., 10,000 per cubic centimetre	.. ..	4,310,000 (Sample taken from can at factory.)

The above case emphasizes two points of importance—firstly, that hand milkers vary very considerably in cleanliness of operation, and, secondly, that cooling plays an outstanding part in determining the quality of the cream on arrival at the factory.

It is obvious that in seeking improvement of the quality of cream delivered to factories it is at least equally necessary to be certain that the good work of suppliers is not endangered or lost on account of faulty methods or carelessness at the factory. The maintenance of factory plant and equipment in a thoroughly satisfactory hygienic condition and prevention of reinfection of the cream and butter in the process of manufacture is not always easy of accomplishment. The high standard of keeping-quality characteristic of most brands of New Zealand butter provides some evidence that methods generally are sound. Nevertheless, a constant laboratory survey reveals how much yet remains to be done. It promptly locates any points where factory methods may be at fault, and quickly determines the success or otherwise of remedial measures. It provides the precise information that is indispensable in establishing and maintaining better control, and in respect to manufacturing details points the way to achievement of a higher and still more uniform standard of quality. Laboratory service thus protects and advances the true interests of all concerned, and its more universal adoption is worthy of serious consideration and practical encouragement.

FARMING IN THE AUCKLAND PROVINCE.

OBSERVATIONS ON FARM-MANAGEMENT METHODS.

P. W. SMALLFIELD, Fields Superintendent, Auckland.

V. THE CENTRAL PLATEAU AND THE WESTERN UPLAND—*continued.*

ROTORUA COUNTY.

September 13th, 1935: Rotorua to Kaharoa to Te Pu. — Rotorua County consists of a high bush-clad tableland up to 2,000 ft. in elevation, broken in the lakes district by a depression with an elevation of 1,000 ft. and in the north falling in a series of broken hills to the coastal plain of the Bay of Plenty. All the land is volcanic, and the soils consist of various volcanic-ash showers and water-sorted pumice in the stream and lake valleys, and vary considerably in fertility. "A warning," writes B. C. Aston (25), "should be given against the practice of speaking of all pumice soils as a class without limitation or definition. To make general statements disparaging the pumice soils is to count disproof by hundreds of successful farmers on what may justly be called pumice lands. It is, on the other hand, dangerous to extol pumice lands indiscriminately as fields for settlement, for instances may readily be given of large areas which are not suitable for settlement by methods in common use." At Kaharoa the surface soil consists of a very coarse ash shower, the Kaharoa shower(26), which covers a considerable area of land in the Rotoiti district and extends as far as Murupara in the east, where at Galatea this coarse shower is in parts overlain by other showers. This Kaharoa shower on the bush-clad plateau round the

lakes gives a soil which is bush sick. Settlement on this land has had a very chequered career; most of the pastures consist of danthonia, suckling clover, and ragwort; streams flow in deep rocky gorges and water is scarce on the plateau—most of the drinking-water is secured from rain-water caught on iron roofs and stored in cisterns; there are a number of abandoned farms. The limonite treatment for bush sickness in sheep is proving successful, but much better pastures are required before this land can be successfully farmed. It would appear that this coarse Kaharoa shower may be too dry for white clover to grow successfully; the subsoil consists of a fine-grained shower and holds moisture well, but it is quite possible that even with top-dressing the coarse surface soil will not support a first-class rye-grass-white-clover pasture. Strangely enough, this coarse, sandy soil grows excellent swede crops. I saw

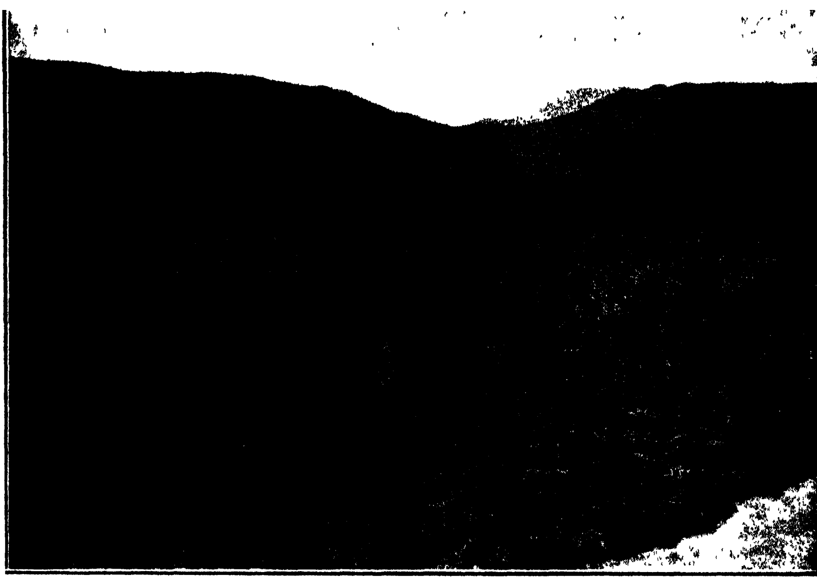

FIG 9. LARCH PLANTATIONS, WAIOTAPU.

[*Photo by E. B. Levy.*

some of the best swede crops I have seen in the province, and the roots were still quite sound; the cultivation for the swedes had obviously been poor, for the lines of the furrow slices could still be seen, and yet all crops inspected were excellent.

December 10th, 1935: Rotorua to Guthrie Settlement and Ngakuru Blocks.—The oldest and most fertile farming-areas on the shores of Lake Rotorua are the sandy loams on the east side of the lake derived from the 1886 Tarawera eruption; farming then spread to the sandy silts surrounding the south and west sides of the lake. These soils are easily broken in and farmed. Farming has now spread south from Rotorua on each side of the main Rotorua–Atiamuri Road. Large areas have been developed for Native-land settlement, and by the Crown under the Land Laws Amendment Act, 1929. Prior to 1929 this land was a

waste of manuka, manoao, and tussock; for the 1934–35 season the developed land produced 381,573 lb. of butterfat, as well as fat cattle, lambs, mutton, and wool. The development of this pumice land has been quite successful, and with top-dressing excellent pastures of perennial rye-grass, cocksfoot, and white clover can be maintained.(27) The scrub is first cleared and burnt, the land ploughed, rolled on the furrow, double-disked, harrowed, rolled; then grass and clover seed are sown with 3 cwt. superphosphate; and after a further 6 cwt. of superphosphate has been applied, during the following twelve months, the pasture land, provided it is annually top-dressed with 3 cwt.

FIG. 10. CATTLE GRAZING YOUNG PASTURE, NGAKURU BLOCK.

The initial development of pumice country is best carried out with wethers and cattle; these quickly turn luxuriant clover-growth into manure, raise the soil-fertility, and help in the establishment of good pastures of rye-grass and white clover. [*Photo by E. B. Levy.*

superphosphate has a butterfat-production of 100 lb. to 150 lb. per acre. The usual grass-mixture consists of perennial rye-grass, 25 lb.; cocksfoot, 10 lb.; red clover, 2 lb.; and white clover 2 lb. For the first three years the dominant pasture-constituent is red clover, which if properly controlled, rapidly builds up the surface fertility and allows of the establishment of high-class rye-grass-cocksfoot-white-clover pastures. Grassing appears an easy matter; but there are certain pitfalls, and red clover, instead of building up the pasture, may destroy it—a luxuriant red-clover growth, uncontrolled, will completely smother out rye-grass and white clover. For the small settler the control of a large area of red clover is not an easy matter; he is usually engaged in dairy-farming, and milking-cows do not thrive on rank red clover—it rapidly becomes unpalatable and has to be mown and wilted before milking-cows do well on it; he has difficulty in harvesting the surplus

growth for the whole of the requirements of winter supplementary feeding—he has not sufficient labour for harvesting a large area, and often makes bad silage and worse hay from red clover through attempting too large a harvest programme. The normal alternative would be to turn to temporary pastures—and this was the old idea in developing pumice land—of Italian rye-grass and red clover before sowing to permanent grass ; but it costs almost as much to sow Italian rye and red-clover pastures as it does permanent ones, and to utilize the produce from these pastures he is still forced to make the whole of the winter-feed provision with hay and silage. Fortunately, the pumice country grows good swedes, and by combining the sowing of red clover with the swede crop, it can be used to build up soil fertility

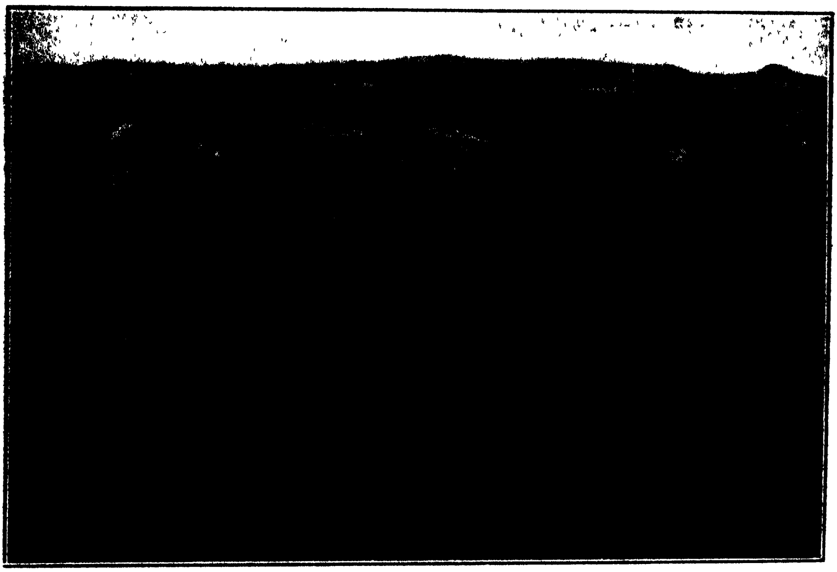

FIG. 11. DAIRY HERD, NGAKURU DEMONSTRATION FARM
[Photo by E. B. Levy.

without doing any harm. The best routine for a settler breaking-in pumice land to follow is first to sow a limited area in permanent grass, containing 2 lb. of red clover, and in the same year sow an area of swedes ; and, after the swedes are drilled, roll, sow 5 lb of red clover, 5 lb. of cocksfoot, and 1 lb. of white clover with 1 cwt. of superphosphate, harrow to cover, and roll again. The division of the areas will be somewhat as follows : Allow 1½ acres of permanent grass for grazing by each milking-cow, ½ acre for hay and silage per cow, and 1 acre of swedes for every five cows. A cow to 1½ acres will keep the pastures fairly well controlled, although the mower will have to be used occasionally for trimming, and a settler can usually manage the harvesting of ½ acre per cow, and the hay and silage saved, together with the swedes, will be sufficient for winter feeding. The temporary pasture sown with the swedes is particularly useful—the red and white clover and cocksfoot do not interfere with the growth of swedes as rye-grass does—in the next

year after the swedes are eaten off, the red clover and cocksfoot plants grow luxuriantly and the produce can be made into silage. Delayed cutting does no harm, or the autumn growth can be kept over for rank feed to be grazed along with the next season's swede crop. After being down in temporary grass for two or three years the land can be ploughed and sown in permanent grass, or ploughed and sown in swedes, and, after the swedes are eaten off, disked and sown in permanent grass in the spring.

Passing from Rotorua through the Hemo Gorge, the road to Atiamuri runs for about twelve miles through Native-land development blocks; at the twelve-mile peg the Whirinaki Road leaves the main road and runs through the Guthrie Settlement and Ngakuru blocks in the valley of

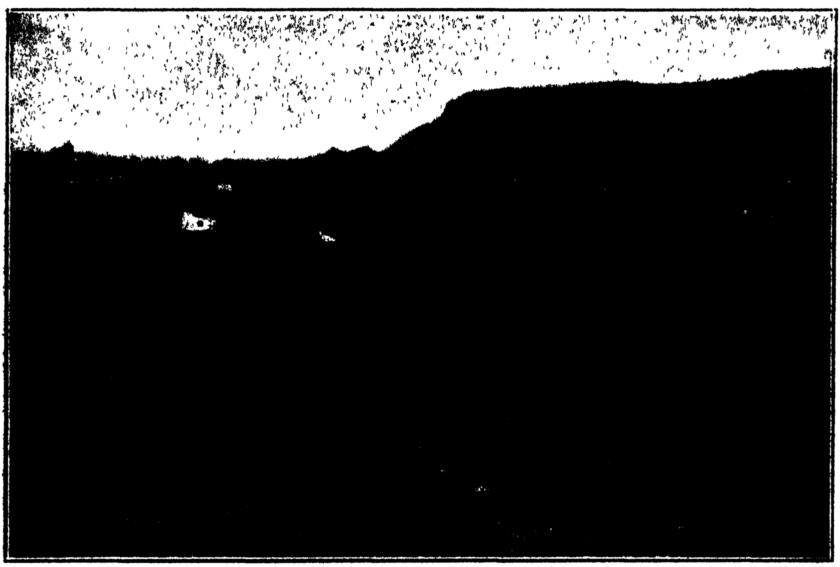

FIG. 12 HOROHORO MOUNTAIN: NATIVE-LAND DEVELOPMENT BLOCK IN THE FOREGROUND. [Photo by E. B. Levy.

the Whirinaki River, which joins the Waikato near Atiamuri. Horohoro Mountain (2,436 ft.) makes a striking background to the Native settlement areas which nestle at the foot of its lower bush-clad cliffs, which at the top are sheer walls of rhyolite. It is remarkable how this light pumice soil has responded to good treatment, and the country promises to be good dairying and (with limonite treatment) fat-lamb raising country. Fat-lamb raising was not successful until the limonite licks were used, but for the past two seasons fat lambs have been successfully raised. Inspected this year's fat lambs on Ngakuru blocks, the lambs looked fairly well, but are not as early this year as last, owing to a long spell of cold wet weather in November which took the bloom off and put the lambs back there will be a number of cull lambs. Fat-lamb raising, if it continues to be successful, is going to help tremendously in the development and farming of this country,

which fattens cattle well; but cattle are not nearly as profitable as sheep. One looks for a gross return of about £1 10s. per annum from a cattle beast, but a ewe for fat-lamb raising will return £1, and four ewes can be carried for each head of cattle. Well did Fitzherbert remark that "shepe is the moste profytablest cattell that any man can have." The initial development of the country can be best carried out with wethers and cattle: these quickly turn the luxuriant clover-growth into manure, raise the soil-fertility, and help in the establishment of good rye-grass and white-clover pastures. Even rye-grass and white clover do not entirely satisfy dairy cows, and I was interested to watch the work a herd of fifty dairy cows, grazing rye-grass and white-clover pastures, had done in cleaning up a rough face of grass, fern, and manuka: the cows would spend an hour on the good grass and then migrate across a creek and up a very steep face to get at the roughage.

WAITOMO COUNTY.

November 22nd, 1935. — Te Kuiti, Piopio, Mairoa, Marakopa.— Waitomo County is a county of contrasts, containing as it does areas of well-cultivated prosperous farms and areas of deteriorated hill country. The road followed crosses the limestone and sandstone hills to the west of Te Kuiti, follows the valley of the Mokau River to Piopio (400 ft.), then climbs the limestone hills to the Mairoa Plateau (1,100 ft.), and thence over the greywacke Herangi Range (Maungamangero, 2,656 ft.) to the valley of the Kiritehere Stream, and follows the coast to Marakopa. The hills near Te Kuiti are generally in clean pasture, with here and there patches of gorse and bracken fern; blackberry is giving trouble on some farms, and goats are being used for control. Towards Piopio I passed on the road quite a number of small lots of ewes and lambs, evidently being taken to dairy-farms for the control of ragwort, which is now beginning to grow luxuriantly. On the light undulating hills in the valley of the Mokau there is quite a fair amount of cultivation work being done—generally land being prepared for swedes. Near Piopio I examined a spring-sown pasture which had followed last year's swede crop. The general strike of grass and clover was only moderate, but the strike was quite good on the cartage tracks through the field, where consolidation was good; no roller had been used prior to sowing. Bracken fern was coming fairly strongly in the spring-sown grass, which was not throwing sufficient feed to allow of the crowding on of stock to crush the young fronds in the curl stage. Autumn sowing is the best for bracken-fern control, for the bracken is dormant in the winter, and autumn sowing allows the grass to become well established so that it provides sufficient feed for the crowding on of stock to crush the young fern fronds.

Rising from Piopio to Mairoa the country shows considerable signs of pasture-deterioration; pastures have deteriorated to bracken fern, manuka, and hard fern, and at Mairoa, where on many farms trouble has been experienced in running sheep, ragwort is plentiful. Here considerable work is being done by camps of unemployed men in reconditioning deteriorated farms for settlement under the small-farm plan. The old pastures consist of sweet vernal, danthonia, Yorkshire fog, ragwort, suckling clover, self-heal, broad-leaved plantain, and piripiri. The easy-ploughable land is being logged up, ploughed,

cropped, and resown to grass. The soil consists of a light volcanic ash shower, the rainfall is very heavy, and the land will require regular and liberal top-dressing if a reasonable pasture turf is to be maintained.

Passing from Mairoa to the Herangi Range, hill-country deterioration becomes quite common. The flats and easy slopes are in quite fair grass, but up the hills the turf weakens, danthonia, brown-top, sweet vernal, and a little suckling clover make the sward, bracken fern and manuka cover large areas. Where bracken fern has been crushed out hard fern occupies a lot of land, and up on the ridges where stock have moved and camped the grass sward is again quite fair. Bracken fern and hard fern give place to one another on this class of country, depending on management. Most of the bracken-fern areas have gone through a phase in which hard fern previously existed; a smother of bracken fern for several years will shade out hard fern, but if the bracken is then crushed out while any hard fern remains there is a return of hard fern.

Manuka, bracken fern, and hard fern are best dealt with primarily by burning and resowing, and subsequently by stocking and top-dressing. Manuka areas should be cut, and, with light scrub, cutting should be delayed until four or five weeks before firing. Hard fern presents difficulties, for it requires a very hot fire to kill the rhyzomes; spraying with arsenic pentoxide has proved a satisfactory method, but it entails a great deal of labour.(28) The general mixture(29) for secondary burns consists of—Perennial rye-grass, 8 lb.; crested dogstail, 4 lb.; brown-top, 2 lb.; *Danthonia pilosa*, 3 lb.; white clover, 1 lb.; *Lotus major*, 1 lb.: total, 19 lb. per acre. In logging-up burns, or on secondary burns where a good deal of timber is burnt, 4 lb. of cocksfoot may be added to the mixture; on hard country 3 lb. Chewings fescue and ½ lb. of yarrow may be added, and the rye-grass and crested dogstail reduced. The aim of the mixture is to give a quick cover with rye-grass and white clover, thus giving feed to enable bracken to be crushed out with cattle, and, as fertility falls, brown-top, danthonia, and *Lotus major* form a sward. Perennial rye-grass establishes rapidly, and, while there remains a certain amount of ash, throws quite good feed. White clover establishes well, but if the land is not top-dressed it goes out after about three years. Brown-top forms a good and cheap cover. Danthonia is slow to establish and produces very little feed for the first three years. Crested dogstail establishes well and carries on the pasture between the going-out of the rye-grass and the coming in of danthonia. *Lotus major* is slow to establish, but produces well after the third year.

After a wet month, the past two days have been fine and all farmers are busy shearing. Piripiri is common on all pastures, and early shearing is needed to get clean wool. This year it is going to be a race between the shearing and the ripening of the piripiri, the heads of which are all ready to ripen with a few days' warm hot weather. At the coast there is a good deal of clean hill country in danthonia, ratstail, and paspalum. Here the climate is warm enough for ratstail and paspalum, and the rainfall is lower than farther inland, and hard fern is not as troublesome.

KAWHIA COUNTY.

September 22nd, 1935: Marakopa to Te Anga.—There is some good land in the valley of the Marakopa River, while the hill country is very similar to that in Waitomo County, the pastures being fairly clean near the coast, but reversion becoming common as one ascends to the Western Upland. Visited a farm near the coast in good clean hill pastures that the farmer was intending to top-dress. Up to ten years ago only cattle were carried on the farm, and the pastures were mainly rye-grass, cocksfoot, and white clover: ten years with breeding ewes, giving close winter grazing, has thinned out the pastures and the main sward consists of danthonia, brown-top, and suckling clover. Rye-grass and white clover still persist as small plants, and top-dressing should increase pasture-production. Up to the Western Upland past Te Anga I inspected a secondary sowing on a manuka burn that was sown last March. The strike was poor, and it looked as if very heavy rain had washed most of the seed and ash down into the valleys. The pasture was not throwing sufficient feed to enable the bracken fern, which was coming back, to be properly controlled. When a secondary sowing fails, it is not worth while expending further money in seed and fertilizer in trying to thicken up the sward. The only thing to do is to make what use is possible of the feed produced, and when the land has again reverted try another secondary sowing. Last season was a bad one for secondary sowings: the weather was very hot and dry in January, February, and early March, and the rain when it did come came in heavy thunder showers which washed down the hills rather than soaked in. From the top of the Western Upland one can see right across the country to the north, east, and south—can see Pirongia, Maungatautari, the Rangitoto Range, Tongariro, Ngauruhoe, Ruapehu, and Egmont, and the great extent of country that forms the Western Upland and the Central Plateau. Much of this land should be permanently forested, for land with a high elevation and a heavy rainfall is difficult to maintain in grass.

December 12th, 1935: Pirongia to Te Rauamoa.—The road from Pirongia to Te Rauamoa passes through four counties—viz., Waipa, Raglan, Otorohanga, and Kawhia. Te Rauamoa (1,200 ft.) is situated on the Westland Upland on the spurs of Mount Pirongia. Originally bush country, the land was grassed after surface-sowing. The climate is very wet. A great deal of the surface-sown grassland has reverted to fern and manuka. There has been a fair amount of grassing after logging up and ploughing, but the pastures obtained are not particularly good, consisting of danthonia, sweet vernal, Yorkshire fog, broad-leaved plantain, catsear, moss, and suckling clover. Piripiri is very troublesome even on the pastures sown on ploughed ground, and lambs covered in the ripe heads looked rather miserable. Inspected a pasture that was sown after ploughing in the autumn of 1930—rye-grass, 20 lb.; cocksfoot, 12 lb.; dogstail, 3 lb.; timothy, 2 lb.; white clover, 2 lb.; red clover, 3 lb.; and *Lotus major*, 1 lb.; sown with 3 cwt. superphosphate and parts with 25 cwt. of lime in addition, and top-dressed with 2 cwt. to 3 cwt. superphosphate for three years. Most of the pasture consisted of rye-grass, white and suckling clover, with a strong addition of fog, cocksfoot, sweet vernal, moss, catsear, and broad-leaved plantain. Where the land had received both lime and superphosphate

the white clover was much stronger than where it had received superphosphate alone. Piripiri was very strong all over the field, and on this country it seems to be very difficult to deal with. Ragwort used to be troublesome here, but is now not much in evidence. This land can be successfully grassed only with a very high farming, and this is not really profitable on steep land at a high elevation, in a very wet climate; much of the steep country will eventually go back to forest.

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VINE-CULTURE UNDER GLASS.

J. C. WOODFIN, Manager, Horticultural Station, Te Kauwhata.

THE purpose of this bulletin is to help beginners by giving information, necessarily somewhat general, about how grapes should be grown. It is not intended to deal with the many variations in method of training, &c., these being merely adaptions of certain principles which are described. A plan for a vinery is not included, it being considered that as one plan would have but a very limited application its inclusion would not serve a sufficiently useful purpose.

Grapes can be and are grown successfully in glasshouses of many kinds, and provided certain general principles are observed there is a reasonable prospect of success. In some cases pot-plants are grown in the same house as the vines, but only in rare instances does this make a good combination. If, however, the house is so built that there is a good deal of glass not obscured by the vines the plan may be successful. When this practice is in vogue the pot-plants should be a secondary consideration, and treatment should be given for the vines just as though there were no pot-plants. The vine requires a fairly moist atmosphere, and a border suitable for good development of roots.

SITUATION.

The vinery should be built in a position that will secure the greatest possible amount of sunshine. In some places it is not possible to so place the building that it will get the sun from sunrise to sunset, hills or tall trees being in the way. Where a choice is possible in such cases the early morning sun should be preferred to the evening rays. The ventilators should be closed before the sun leaves the roof; the temperature will then rise and a fair degree of warmth be maintained far into the night. It is after midnight that the heaviest fall in temperature takes place. The earlier the warmth can be secured the

better, and so the early morning sun is more valuable than that of evening. In places where the configuration of the land is such as to give the benefit of both morning and evening sun the fall in temperature is of short duration. In such places grape-growing is comparatively easy, and early ripening takes place.

Description of Vinery.

The span vinery (or, as some term it, the ridge vinery) is most economical because there is no waste back wall. For an open situation this is the best form. The general dictum is that such a house should run north and south. In this position the sun rises on one side and sets on the other. There is abundant evidence, however, that, at any rate in the warm climate of northern districts, it makes practically no difference which way the vinery faces, and it may be built in the position which is most convenient. The side walls should not be less than 4 ft. high. A lesser height than this, unless the angle of the roof be sharper than is necessary or advisable, will make the working of the vines very inconvenient. Side walls are frequently built up of solid material, either boards or concrete, though the present tendency is to make them partly or wholly of glass. Use of glass is much to be preferred, though a little more expensive.

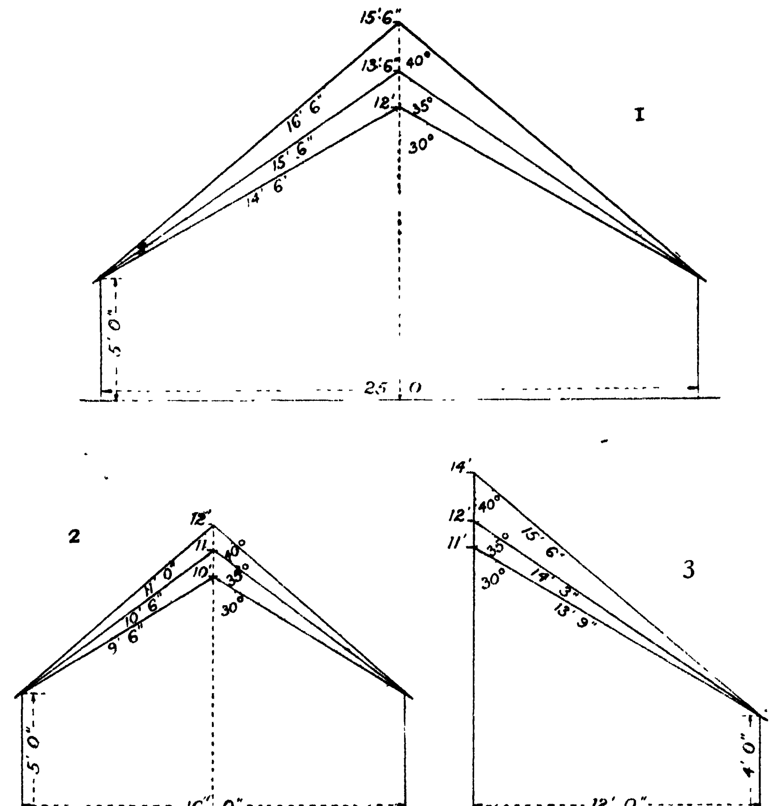
A lean-to house should face north-west, with a little variation one way or the other as surrounding conditions may render advisable according to the factors referred to under the heading "Situation." The front wall will be the same as for the span house. The lean-to with a roof pitch of 45° is the best form of house for the production of early grapes where artificial heat is employed. For other than early houses a pitch of 30° to 40° is ample. A lower pitch than 30° should be avoided, except in a very dry climate. In rainy climates a fair pitch is necessary to secure a proper movement of the air and to avoid a stagnant atmosphere, so that 35° or 40° would be better than 30°. The accompanying diagrams explain the application of the different angles mentioned. The lower the pitch the lower becomes the height of the end walls, and consequently the expense of building is reduced.

Ventilation should be ample, particularly at the top Good bottom ventilation is also required in the warmer parts of New Zealand. In the case of span vineries ventilators should be placed in each end of the house, and in the case of lean-to houses in the back wall always as near the apex of the roof as possible.

Size of Vinery.

When the cost of the building is compared with the value of the crop it accommodates it will be recognized that a very small vinery is the one that will give the lowest proportionate return. On the other hand, very large vineries are not economical, as the extra strengthening required is costly. The following statement on this matter by a well-known English authority is of interest: "Probably there are more vineries built 25 ft. or 30 ft. wide for market purposes than any other width, though houses 15 ft. or 16 ft. wide are common, and vines do very well in them." Above 30 ft. wide, houses tend to become unwieldy, and the expense of building is considerably increased. Most of our leading

nurserymen have at some time or other gone in for building giant glass-houses, but in nearly every case when building further houses they have returned to the smaller sizes. In the same way the length of a vinery should not exceed 200 ft., as excessive length creates difficulties in the keeping-up of uniform temperatures in all parts of the house, and also in ventilation, and even in the working of ventilators themselves. At Worthing, England, the favourite size seems to be 160 ft. long by 25 ft. or 30 ft. wide. In the north of London the vineries run somewhat longer, especially in the large nurseries, 200 ft. being the most common. From all points of view the most workable size is the Worthing standard.



SECTIONS OF VINEHOUSES, SHOWING PITCH OF ROOF, ETC.

Fig. 1. Span-roofed house, 25 ft. wide, showing height at centre, and length of rafter at angles (from the horizontal) of 30°, 35°, and 40° respectively. If the side walls are built 4 ft. instead of 5 ft. high, as is commonly done, the height at centre will be 12 in. less.

Fig. 2. Span-roofed house, 16 ft. wide, with side walls 5 ft. high, showing height in centre, and length of rafter at angles of 30°, 35°, and 40°.

Fig. 3. Lean-to house with front wall 4 ft. high, showing height of back wall, and length of rafter with roof pitched at 30°, 35°, and 40°. Note.—It is often convenient to gain head-room by lowering the floor, thus saving in height of wall.

THE TRELLIS.

Wires for training and support of the vines are preferably fixed vertically, No. 12 galvanized wire answering this purpose. Long screw-eyes, or other suitable supports, should be fixed to each rafter, these being long enough to keep the vine-rods 18 in. from the glass; one wire to attach the vines and one in between the vines to tie the laterals to. One of the most frequent mistakes is training the rods too close to the glass. The leaves and sub-laterals occupy the space between the rods and the glass, and if there is not plenty of room the leaves press against the glass. Moisture that collects during the night is not then readily dispelled, and remains until evaporated by hot sunshine. The result is scalded leaves and, frequently, attacks of mildew. There should be a clear space between the leaves and the glass: This allows a free current of air to pass between them, so that moisture is quickly dispelled and the leaves function properly. Good grapes cannot be grown unless there are healthy leaves.

THE BORDER.

The soil used should be of a moderate depth and of such a character that the roots are able to work freely in it. If drainage is naturally good so much the better; if not, good drainage must be provided. The spouting should be fixed to catch the rain that falls on the roof of the house. This is not of great consequence during summer-time, except possibly during heavy downpours, but in winter, when the greatest amount of rain falls, if there is no spouting the soil close to the building becomes sodden, cold, and stagnant, and cases are known where the roots have been killed, and the vines have died from this cause. Water from the spouting should be led into the drains, or at least to a position where it can get away readily from the border.

In some cases private vineries are built and planted with vines in unsuitable soils, which sometimes are very little better than a poor clay. A prepared border is necessary in such cases to obtain satisfactory results, the best material for the purpose being the top spit from an old pasture. The site should be excavated to a depth of at least 30 in. Where drainage is necessary the pipes should be placed 6 in. deeper at the foot of the border. The method of filling is to cut the turves about 3 in. thick, placing them as cut with the grass side down. When a layer of the turves has been placed, cover with a layer of loose crumbs of the same soil, which will close up interstices. Over this apply a dressing of carbonate of lime about ½ in. deep, together with bone-meal at the rate of 2 oz. per square yard. Continue in this way until the excavation is refilled, finishing with about 6 in. of loose soil into which the same amount of lime and bone-meal should be worked.

For commercial purposes the house should be built where the soil is of a suitable character. Trench to a depth of 36 in. at least. Arrange the trenching so as to leave the topsoil still on top. During the trenching of the soil apply lime and bone-meal, as with the made border, to a total amount of ½ lb. of bone-meal per square yard, to be mixed with the soil as trenching proceeds.

Assuming the soil and other conditions to be suitable, the best site for the house is on an old pasture. Where the outside border is level with the floor of the house, it is better to plant the vines inside the house, in which case the border should extend to about 2 ft. inside the walls, which should be built with arches so as to allow the roots to extend into the outside border, which they invariably do. The roots always go outside to the sun when they can do so; therefore all that is required inside is just sufficient border room for planting. In cases where the roots are to grow inside the house—this being preferred where the vines are forced, as watering is under control and the soil is warmer—the whole of the space should be trenched in the same way as recommended for outside borders. In some cases the site chosen may be low or the subsoil wet. It is then advisable to cart soil to raise the borders. On slopes it may be necessary to lay drains to cut off excess water that would reach the borders by seepage. It always should be borne in mind that a sweet rooting-medium is of vital importance. A dry border can be watered; if it becomes too wet remedial measures should be resorted to.

PLANTING.

The vines should be grafted on phylloxera-resistant stocks. The unions of grafted vines should be at least 2 in. or 3 in. above the ground when planted. If planted so that the union or part of it is below the surface of the soil, the scion throws out roots and ultimately the stock perishes. After planting, soil should be mounded up to several inches above the union, so that when the soil settles down the union will still be covered. This earth should be removed in January and any roots from the scion cut off. The earth is then replaced and removed finally in the autumn. The unions of aerial grafts such as the yema or bud-graft and green-grafts do not require mounding up. Before planting, the vine should be pruned, leaving two to four buds (see statement regarding first year's training). Any roots that may be damaged should be shortened back beyond the injury. A broad hole 6 in. deep is then made, the roots spread out on the bottom, and the soil returned and treaded firmly. If the soil has become dry the vines may be watered in. July is a good time to plant.

The correct distance apart for the rods is determined partly by the habit of the variety and partly by the purpose for which the vines are planted. When grapes are grown for private consumption there is a very natural desire for extra-fine fruit and large bunches. It may be said here that most if not all of the older standard works in vine-culture have been written for the purpose of showing how to grow fine grapes. The commercial aspect has either not been considered at all or the systems recommended have been based on the supposition that fine bunches are of equal value for either purpose. The fact is that as a rule the commercial grower does not wish for large bunches. Three 1 lb. bunches are more useful to him than one bunch weighing 2½ lb. or 3 lb.; in fact, he wants a heavy crop of rather small bunches. In obtaining this kind of crop it is likely that the quality may suffer somewhat, but with

good management fair quality can be secured, and the heavier crop will more than make up for a slightly lower price per pound. This explains, at least in part, why commercial men with experience allow more than one bunch to each lateral, which is the maximum usually recommended.

For commercial purposes the rods of Black Hamburg, which is the principal variety grown, and of similar varieties of the sweet-water group of varieties, should be 30 in. apart. More strongly growing varieties, such as Gros Colman, Gros Maroc, and Alicante, should be 36 in. apart. In private houses these distances are, for reasons already explained, increased to 4 ft. and 4 ft. 6 in.

DISTANCE BETWEEN PLANTS.

It is well known that vines succeed best under the extension system, under which the historical specimens have been grown. The Hampton Court vine—planted in 1769—occupies a house 66 ft. long and 30 ft. wide; it produces some 1,700 bunches annually. The old vine at Cumberland Lodge, Windsor Park, occupies a house 138 ft. long and 20 ft. wide, and ripens about 2,000 bunches of grapes. Another at Kinnell House, Breadalbane, Scotland, fills a house 172 ft. long by 25 ft. wide. The leviathan of vines in England is that at Manressa House, Roehampton. Planted in 1862, it occupies a house 224 ft. long. It ripens from 600 to 800 bunches annually, some of which weigh between 3 lb. and 4 lb. The Manressa vine is growing in the natural soil of the situation—a free clayey loam.

Free extension leads to long life in the vine, its vigour being maintained by that system. Such a system, however, is not suitable for a commercial house, as it takes too long to fill a house. Restricted growth is necessary for this purpose, and is generally adopted also in private establishments, a greater number of vines being planted so as to fill the space quickly. Practice varies in so far as some growers allow each vine to make two rods and others only one. The general opinion is in favour of two rods, although one rod answers very well provided there is a long rafter, say, not less than 16 ft. Where the rafter is shorter than that the vines should have two rods. Vines with a very short run weaken sooner than those that are less restricted. Two rods can be worked up from one vine as quickly as one, but a larger number would take a longer time, as only two can be worked up simultaneously. Cases are known where vines growing in narrow span-roofed houses are trained up one side and down the other. It would be far better to plant on each side and allow two rods to each vine. Where the situation is such that a border can be arranged on one side only, the trellis at the apex of the roof should be fixed as low as convenient so as to reduce the curve of the rod as much as possible.

It has been stated earlier that planting inside the house is the better. There is no obstacle to this if the building is of wood, but where concrete foundations and walls are erected it is not convenient unless the wall is built in arches. Outside planting answers nearly or quite as well, holes being left in the wall to lead

the vines through. In this case it is advantageous to plant vines with rods long enough to reach into the house, the young vines being pruned to that length. Some growers plant the vines a year before building the house, there being then no difficulty in getting a rod or two to reach to the inside. When the vines are planted inside the house they should be cut down to two buds.

The distance apart at which to plant depends on the number of rods to be allowed. If two rods are trained up, then there is required only half the number of vines that would be necessary if only one rod were allowed. If single-rod vines are to be grown at a distance of 2 ft. 6 in. apart, then the end vines should be planted 15 in. from the ends of the house, and the remainder 2 ft. 6 in. apart If two rods are to be grown, then the end vines should be 2 ft. 6 in. from the ends and the others 5 ft. apart. The end rods should be trained up 15 in. from the end of the house, the rods throughout being 2 ft. 6 in. apart.

Training the Vines.

The developed vine consists of one or more rods. Alternately arranged on either side of a rod are processes termed "spurs"; these are spur-like projections caused by cutting back the side growths. The growths that proceed from the spurs are termed laterals. During the season of growth side shoots come from the laterals, these being termed "sublaterals." From various parts of the growing lateral, and sometimes from the upper part of the stem of a bunch, there are formed leafless processes with spirally twisted ends; these are the "tendrils." When a young rod is being formed its extremity is termed the "leader." Both laterals and sublaterals are formed on young growing rods as well as on old rods, but in the former case they are, of course, of later growth, appearing as the leader lengthens. At each joint—*i.e.*, where a lateral issues from the main rod—there is a leaf on the rod, and at the base of each leaf there is a bud which produces a lateral the following year. The leaf and the bud which develop on the rod do not persist after the first time of bearing fruit; both buds and leaves then arise on spurs formed by the shortening of the first bearing-laterals.

Leading Vines into the House.

Where the vines have been planted two years before the erection of the house and have made good rods they should be able to produce a few bunches of grapes the first season following the erection of the house. If the vines have been planted only one year, then at pruning-time sufficient length of rod should be left to reach into the house—that is, supposing the house has been erected so as to leave the vines outside. In such cases, whether it is intended to work up one rod or two rods to each vine, only one rod should be taken in. If, however, the house is built over the vines two rods may be left if desired, provided they have been secured in the right position. In either case the one-year-planted outside vines will require the same training as those newly planted

inside the house. Those having a year's start should, however, make more growth than those newly planted.

In the case of vines planted outside after the house has been erected, a strong growth should be selected for leading into the house. This should in the first place be secured to a strong stake inserted in the ground at an angle so that it will be led to the aperture left for its admittance to the house. As soon as the point of the young rod reaches the aperture it should be led in, and, when sufficient growth is made, tied to a stake leading to the bottom wire. If the vine is to have only a single rod it should, on the young rod reaching the wire, be led straight up the roof; but if the vine is to have two rods the tip should be pinched off so that the two laterals nearest the top will form the rods, these being trained horizontally for the correct distance and then led up as in the case of the single rod.

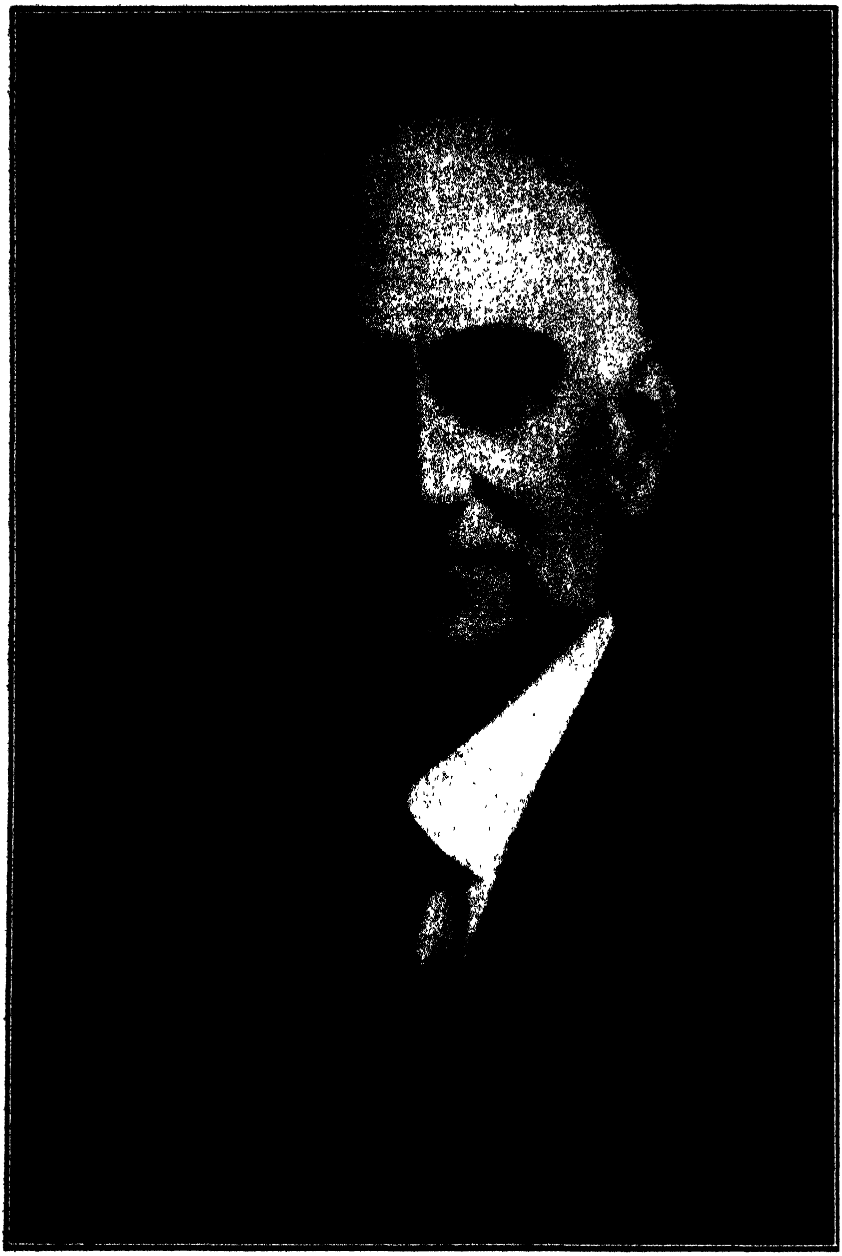
Establishing Strong Plants.

The firm establishment of the vines is the first care of the grower. This is secured by inducing the vines to make a vigorous growth, which in turn causes the formation of a proportionate amount of root-growth. When borders are well filled with healthy roots good lateral growth in after-years can usually be counted on. In former times it was customary, after the first season of growth, to cut the young vine back to within a bud or two of its base; but this plan has now been generally abandoned, and with a view to bringing the vine into earlier bearing a length of 3 ft. to 4 ft. or more of the young rod is left. In carrying out the former plan the growth made during the first season was allowed to go almost unchecked, with merely a pinching of laterals here and there to prevent overcrowding. This will not answer in modern practice.

It is necessary to deal with growth in a systematic manner, for it is the nature of a vine to make its strongest growth at the top. The farther the vine reaches the greater is the strength of the top growth as compared with growth on the lower part of the rod. In fact, the top growth robs the bottom growth of sap. When a certain length of the young rod is to be left some restriction of growth is necessary, or the lower buds will be left very weak. It is well known that the lower spurs often produce very poor bunches, while the best bunches are usually borne on the upper half of an established rod; the natural tendency is always in this direction. The difference is most marked when a rod has been forced up too quickly, and is further accentuated by neglect to control growth during the active period of the first season.

(To be continued.)

An order of the Ministry of Agriculture, London, England, prohibits the landing in England and Wales of any living parts of plants (except the seed) of sugar-beet and mangel from abroad, except under license from the Ministry, and requires certain prescribed certificates, except in the case of a consignment consisting wholly of potatoes, to include a statement that the consignment does not contain any plant of sugar-beet or mangel The object of the order is to prevent the introduction to the United Kingdom of virus diseases which have proved injurious to the sugar-beet industry on the Continent.



MR. A. H. COCKAYNE, RECENTLY APPOINTED DIRECTOR-GENERAL OF THE DEPARTMENT OF AGRICULTURE.

A. H. COCKAYNE APPOINTED DIRECTOR-GENERAL OF AGRICULTURE.

MR. A. H. COCKAYNE, Assistant Director-General since 1929, has been appointed to succeed Dr. C. J. Reakes as Director-General of the Department of Agriculture.

Because of the economic, technical, and scientific developments of recent years, numerous important, novel, and complex problems promise to be associated in the future with the rural industries of the Dominion. Many of these problems fall within the sphere of work allotted to the Department of Agriculture, and so Mr. Cockayne, in taking over the reins in the Department, becomes responsible for providing a public service of considerable and increasing moment in our national economy. Mr. Cockayne brings to this task a remarkably thorough and broad knowledge of the practices and problems of the farming of New Zealand. Indeed, his knowledge is so outstanding in its extent and wealth of detailed information that it is recognized by his co-workers to be unequalled.

Some measure of the encyclopædic character of Mr. Cockayne's knowledge of farming is provided by his contributions to the *Journal of Agriculture*, in the first number of which, published in 1910, he dealt with aspects of our tussock grassland. Since then he has contributed articles on such widely diverse matters as spraying-oils, weed-control, insect pests, plant-breeding, seed-testing, shelter-trees, plant-diseases, sources of honey, seed-production, mineral content of pastures, costs of work by tractors and by horses, the structure of wool, and the feeding of dairy cows.

Pastures greatly dominate New Zealand farming, and the better-class New Zealand farmers are in the van, when compared with the better-class farmers of all countries, as regards their results in profitable pasture-production and pasture-utilization. The eminently satisfactory standard of our grass-farming may be attributed largely to the pioneering work of Mr. Cockayne, and to the inspiration and guidance he has given subsequently to other grassland workers. Incidentally, during recent years Mr. Cockayne, far from holding that our present standard of grass-farming is fully satisfactory, has been a persistent and strong advocate of the need not only for more knowledge, but also for more effective application of the current knowledge.

Latterly, as Assistant Director-General, Mr. Cockayne has greatly extended the sphere of operation of his energy and insight into many major matters connected with our sheep-farming, pig-keeping, dairying, and horticulture. Hence he comes to his present position peculiarly well equipped with knowledge of the widespread ramifications of the Department of Agriculture. The somewhat popular association of the Public Service with stereotyped outlook and methods gives interest to the fact that Mr. Cockayne has not exhibited any tendency to overvalue routine procedure or orthodox opinion.

Mr. Cockayne's faculty of critical analysis has made him aware of the need of improvement and progress in our farming. His originality and constructive imagination combined with his ability to

provide strong word-pictures of his ideas has made him at times a fighting prophet of new views. In short, his past work provides evidence of capacity for particularly progressive intelligent leadership.

Mr. Cockayne's career has many interesting phases. Undoubtedly he owes much to the influence of his eminent father, the late Dr. Leonard Cockayne, C.M.G., F.R.S., who was a world leader in the sphere of botany in which he specialized, and who has passed on to his son the ability to assess accurately the relation between scientific data and practical affairs, so that conflict between theory and practice is avoided.

After attending Canterbury University College as a student, Mr. Cockayne became assistant demonstrator in biology under Dr. Dendy. His service in the Department of Agriculture commenced in 1904, when he became assistant biologist, the late Mr. T. W. Kirk then being biologist. Mr. Cockayne was biologist from 1909 to 1921, when he became Director of the Fields Division. In 1927 be became Director of the Plant Research Station on its establishment, and continued as Director of the Fields Division. In 1929 he became Assistant Director-General, retaining the directorship of the Plant Research Station.

THE WINTERING OF HOGGETS.

J. E. McIlwaine, Veterinarian and Animal Husbandry Officer, Department of Agriculture, Palmerston North.

The successful wintering of hoggets with a minimum of losses is a branch of sheep-farming which requires some considerable skill, experience, and knowledge of sheep-husbandry which may be little known to those farmers normally well versed in other aspects of sheep-farming. Some men make a special feature of wintering hoggets, whereas others wish to have nothing to do with it, and others, again, are compelled to winter a certain percentage of their later lambs. Stud-breeders, as a rule, make a special effort to carry over their hoggets safely and generally are very successful. Success or failure in dealing with this branch of sheep-farming is of special importance in a season such as farmers are experiencing at the present time. The great contrast between the past season and the previous one requires to be given due consideration by all farmers who are interested in the wintering of hoggets. The heavy rainfall throughout the recent summer and autumn has resulted in an abundant growth of feed for sheep in all parts of the North Island. Many farmers, and especially those engaged in the wintering of hoggets, would prefer a drier season, especially during the autumn months. It is generally accepted that young sheep do better on a drier, more fibrous feed than that at present available. This is confirmed by the experience of those who specialize in fat-lamb production—although there was an abundance of feed for both the ewe and lamb the killing season for lambs was this year later on account of the lack of finish and bloom on the early lambs sent forward. From this evidence it will be seen that the nature of the

season and the feed produced play an important part in the raising of young stock. There is no doubt that more difficulty is experienced in an exceptionally wet season with an abundance of feed than is the case in a more normal season. Farmers have been well advised to adopt precautionary measures in such a season to prevent undue losses later on.

The great majority of sheep-farmers has long recognized the important part played by cattle in the control of their pastures so that the sheep, which grazes more closely, may get the young leafy and more nutritious herbage. In an abnormal season such as the present one many farmers have experienced difficulty in getting enough cattle to control the coarser stronger growth of pasture.

This is a branch of stock-management which is difficult to foresee and judge correctly in the early part of the year, as too many cattle could easily be used in a season of drought. It is therefore of prime importance that each farmer should take stock of his own position and of the condition of his hoggets before the season becomes further advanced. Many have done so already, as evidenced by the large number of inquiries which have been received. There are others, however, who may not have given the due consideration to the special conditions which now apply.

As a rule, the dairy-farmer who buys a few cull lambs experiences little difficulty in successfully carrying them through the winter. One might well ask the reason why. It will be obvious in this case that one of the important reasons for his success is that the lambs are placed on well-grazed and well-controlled pastures, pastures which have been eaten down by the dairy herd. Another important reason is that such pastures have not been stocked with sheep throughout the season and are not fouled or "sheep-sick" and are free from parasitic infection. A further feature of the success lies in the fact that only a few lambs are carried and that a free range and great variety of feed are available and that overstocking is not a factor in such cases.

The sheep-farmer who is wintering a large number of hoggets has not such favourable conditions; in fact, in many cases he has to meet the very opposite conditions to those of the dairy-farmer as just described. His pastures may have "got away" in a season like the present one, he may be understocked with cattle through sheer inability to obtain sufficient for his requirements, his pastures may be "sheep-sick," and, owing to a shortgage of cattle, he may have stocked heavily with sheep, resulting in fouling of his pastures and a heavy infection in regard to parasites. Careful shepherding of hoggets is therefore very necessary to detect those which are not doing well, when immediate steps require to be taken to overcome the cause of the trouble. Unsuitable feed conditions with a heavy infestation of worms undermines the constitution of the hoggets, resulting in coughing and scouring and, on occasions, a serious mortality. A harshness and openness of the wool develops, and if the affected hoggets are examined more closely it will be found that the skin is pale and the animals are in poor condition.

Those most seriously affected should be segregated and dosed with a suitable worm-medicine and given a change of pasture as outlined above. Many farmers will have such crops as rape, chou moellier, and barley available for this change of feed, and many will use roots, silage, and hay later on. Feed of this nature will be comparatively free from parasitic infection and, if suitable worm-medicine has been used in conjunction with feed of this nature, good results can be expected. Many depend almost exclusively upon pasture, and here considerable judgment is necessary to use the best-drained paddocks and the least-contaminated paddocks for the hoggets. If silage and hay have been saved for winter feeding the aftermath paddocks will provide clean pastures until the silage and hay can fill the gap. A rising plane of nutrition, so far as it is possible to obtain it with the feed available, is an ideal to aim at as the season advances. As the weather becomes colder, more feed is required.

A suitable and very effective worm-drench recommended by the Department for the treatment of parasites in hoggets is prepared as follows: Dissolve 1 lb. of bluestone in 5 gallons of water, and add 16 fluid ounces of a solution of nicotine sulphate. Give the hoggets ½ fluid ounce of the mixture at regular periods of three weeks, or as considered necessary. It is not necessary to fast the hoggets before dosing, but it is advisable to keep the stock away from water for two hours after dosing. The above solution is more concentrated than that previously recommended, but the dosage per head has been reduced proportionately.

The necessity for an adequate and nutritious diet in the successful wintering of hoggets has been emphasized above. Good feeding is the sheet-anchor of successful results and too much stress cannot be attached to it. Whether the farmer has been using the worm-medicine mentioned above, worm-tablets, or other preparations on the market, the necessity for adequate feeding of hoggets still remains. Much of the success achieved by the stud-breeder can be attributed to his close shepherding and his due recognition of the advantage to be gained by the use of supplementary feeding such as chopped roots, chaff, and other foodstuffs.

Chaff is frequently used in the South Island where the winter grass is scarce and there is undoubtedly scope for the greater use of chaff, and good lucerne or clover hay in the wintering of hoggets in parts of the North Island. The difficulty experienced in getting the young stock to eat dry feed while green feed is available can be overcome by the stud-stock breeders and should not prove impossible in the management of ordinary flocks.

The advantage of using some dry feed in a season like the present one lies in increasing the fibre content of the soft feed, in providing variety in the diet, in assisting to prevent scours, and, above all, in providing a supplement in cases where grass is in short supply, a supplement which can be guaranteed to be free from the eggs and larvæ of the several kinds of parasitic worms which undermine the health of our hogget-flocks. The successful wintering of hoggets is in many cases a specialized branch of sheep-husbandry requiring close shepherding and observation and a close study of feeding and attention to detail in management.

RESULTS FROM PASTURE TOP-DRESSING IN CANTERBURY.

R. McGILLIVRAY, Fields Superintendent, Christchurch.

THE successful manuring of pastures in Canterbury, owing to dry climatic conditions, presents more difficulties than is the case where the annual rainfall is greater, but the experience of the farmers mentioned in this article indicates very clearly that autumn top-dressing pays, and this is confirmed by pasture top-dressing trials conducted by the Fields Division of the Department of Agriculture in the dry districts in various parts of Canterbury and Marlborough.

In most cases there has been a distinct response to lime applications, and in the case of applications of lime plus superphosphate wonderfully improved pastures have resulted where applications have been made in the early autumn and in sufficient quantities. An application of 1 ton carbonate of lime plus a minimum dressing of 2 cwt. superphosphate per acre seldom fails to give excellent results.

The failures that one hears of at times can be attributed largely in the first place to inadequate applications of both lime and fertilizers, and secondly to spring applications to dry pastures in dry districts. This is a practice inviting failure, and top-dressing in this way for quick results is largely a waste of effort and of outlay. The meagre applications of lime and phosphates, as practised by some farmers in their top-dressing, have been described aptly as "sending a small boy on a man's errand." A foundation must be laid, and when this has been done lighter annual dressings may then give results.

In addition to the cases mentioned in this article there are many other farmers who are top-dressing successfully in Canterbury, and whose conditions are in no way more favourable than their neighbours; yet success attends the top-dressing of one group and failure of the other group. Success is generally closely allied with early and adequate applications of lime and phosphate applied to good types of vigorous and persistent pasture constitutents.

Mr. Eric C. Gardiner, of "Vulcan Downs," Motunau, North Canterbury, has a holding of 2,472 acres, comprising flats, downland, and fairly steep hills. Mr. Gardiner commenced top-dressing with superphosphate seven years ago. Prior to that time he wintered approximately 2,000 ewes and some cattle. He formerly did considerable cultivation for the purpose of maintaining his stock, and this work cost him, on an average, £800 per annum. Since commencing top-dressing he has disposed of his team and now uses a caterpillar tractor when top-dressing. He annually top-dresses 800 acres and the cost of this work is about £400. The work is carried out in the autumn and as early as February at times. Fairly steep hillsides and manuka-covered faces have been treated, and the present condition of the pastures on these areas rapidly dispels any doubt with regard to the efficacy of top-dressing on this estate. Some parts of the tussock-land have been top-dressed without any seed being sown, and now carry an excellent sward of mixed grasses and white clover. On the manuka areas the scrub was cut and burnt and grass-seed sown. These areas are top-dressed annually, with the result that there is now excellent pasture on land that a few years ago was quite useless.

Last year the total sheep wintered amounted to 3,535, of which 2,560 were ewes, and in addition there were 90 head of cattle, and these, seen in November, proved to be in prime conditon. The lambing percentage ranges from 100 per cent. to 110 per cent. This percentage represents an increase of 10 per cent. compared with the lambing obtained prior to top-dressing. All sheep troubles have been reduced to a minimum and the fleece-weight has increased by 1½ lb. per sheep. Prior to top-dressing, the lambs were practically all sold as stores. Generally not more than two trucks went away fat. Conditions have completely changed under top-dressing, and now there are only a few trucks of lambs not sent away fat off their mothers. Mr. Gardiner has had 1,669 lambs in the works by the 23rd of January, with a weight of about 34 lb. Last season his first draft of nearly 1,000 averaged just under 35 lb. and all were away to the works by the end of January. This, in a year of extreme drought, speaks well for top-dressing and, as Mr. Gardiner explains, top-dressing has transformed his estate from a purely store-stock undertaking into a fat-stock one. Lime is now being used, and it is quite evident from the condition of the pastures where it has been applied that it is going to still further enhance the value of the grazing on this property.

Mr. C. E. T. Elmers, dairy-farmer, Ellesmere, has been top-dressing for the past six years. As a result of the first year's top-dressing there was an increase of 420 lb. of butterfat from the herd. Some top-dressing was done in the second year, but in the third year, owing to the low price of butterfat, top-dressing was not undertaken, with the result that there was a heavy fall in butterfat-production. The owner then realized that it did not pay to cease top-dressing, and in the fourth season applied 1½ cwt. super per acre to 60 acres, and production went up by 61 lb. of butterfat per cow. Mr. Elmers during the fifth and sixth season has increased the quantity of superphosphate used and is also now using considerable quantities of carbonate of lime, with most gratifying results. On this farm one field of 12 acres was top-dressed after a hay crop was secured and closed up for the production of red-clover seed. The clover made most vigorous growth and threshed 34 sacks of seed (approximately 6,800 lb.), or nearly 3 sacks to the acre. This result could not have been achieved except with the aid of an application of top-dressing material, and the owner is of opinion that in his general management it will pay to spend at least £1 per acre per annum on lime and fertilizers.

Mr. James Reid, of Riversleigh, Darfield, has a farm of 428 acres. He has been top-dressing some of his fields annually for eleven years, and these have shown a consistent improvement both in pasture covering and general production. Approximately 180 acres of pastures are top-dressed annually with superphosphate at the rate of approximately 1½ cwt. per acre, and it can be said that in addition to this all crops grown are also manured. There are on the farm 120 acres in wheat and oats and about 300 acres in pasture, roots, and green feed, on which 900 stud English Leicester, Corriedale, and Ryeland sheep are wintered. Mr. Reid is a firm believer in early autumn top-dressing, as he finds that the grass grows much longer into the winter and comes away much earlier in the spring, thus the low-production period is greatly shortened. The top-dressed pastures also stand up much better to dry weather and are far more permanent than are those not treated.

Mr. Reid states that since commencing to fertilize his crops, including his pastures, he has at least doubled the carrying-capacity of the farm. He also points out that the increased pasture carrying-capacity is not the only benefit, as the grain crops following a pasture that has been top-dressed show a very material increase in yield. Mr. Reid has not limed to any extent, and considers superphosphate to be the ideal fertilizer for his relatively dry conditions.

Mr. W. J. Inch, Te Pirita, has a farm of 1,100 acres varying in quality from light stony-plains land to some good river silt. This farm is situated on the north bank of the Rakaia River about fourteen miles inland from Bankside. The owner has been liming and using fertilizers for about six or seven years, and success was attained in the first top-dressing season, although it took two or three seasons to obtain maximum results. The usual time for applying fertilizers is the March–May period, but every endeavour is made to get the work done as early as possible so as to take advantage of the late-autumn and early-winter rains, as the annual rainfall of the locality is relatively quite low. Prior to top-dressing, the carrying-capacity of the farm was 1,100 sheep, of which 850 were ewes. The carrying-capacity is now approximately 1,800 half-breds, of which about 1,150 are ewes. The amount of wool clipped has shown an increase of at least 1 lb. per sheep since top-dressing commenced, and the lambing percentage shows a great improvement, and last year was 118 per cent. In estimating this percentage all dry ewes were included in the count. Since top-dressing commenced the pastures last much longer and large quantities of hay are made where none could be saved before. It has also been noticed that the pasture-plants present on the top-dressed areas withstand dry weather remarkably well and show a rapid growth when rain is experienced. The saving of white-clover seed has also become possible and is at times a highly profitable undertaking. Mr. Inch used superphosphate at the rate of 2 cwt. per acre and lime at about 10 cwt. per acre.

The experiences of the above-named farmers were taken as typical of what is now happening in many districts, and many other similar cases could be recorded. In almost all cases there is very definite evidence that early autumn is the most favourable time in this district in which to apply fertilizers to established pastures. The value of applications of lime are often very distinct, and this is especially so when in combination with superphosphate.

At Otakeho, Taranaki, thirty sows and thirty store pigs grazed for five months on four acres of oats sown in the autumn. The pigs had access to water and, apart from being fed for two weeks on boiled meat, had no other feed. The results were reported upon as quite good.

Several varieties of swede and turnip which are highly resistant to club-root have been introduced, and have been put under thorough trial in competition with standard varieties, chiefly in Southland. After several years of trial the Bruce turnip and the Wilhelmsburger Otofte swede have proved highly resistant It is not too much to say that the use of such varieties as these on badly infected land means the difference between a reasonable crop and an utter failure in many cases.—*Director of Fields Division, Annual Report.*

CERTIFICATION OF SEED POTATOES.

PROVISIONAL CERTIFICATES ISSUED FOR SEASON 1935-36.

PROVISIONAL certificates are issued with the object of affording growers some indication of the general standard of their crops and assisting them in the disposal of their seed. Certification tags to be attached to the sacks are issued later, provided that an officer of the Department of Agriculture inspects the graded seed potatoes and is satisfied that they are still of the same standard of purity and freedom from disease as was indicated by the field inspection.

Each crop has received a group-number, which indicates as accurately as possible the merits of its produce for seed purposes in relation to the merits of the produce of the other provisionally certified crops of the same variety. Group 1 is the highest and Group 8 the lowest. The difference between any two consecutive groups is small, and in making comparisons the cost of seed and transport should receive consideration.

Crops are also divided into two classes—namely, (1) Certified "Mother" seed; (2) certified "Commercial" seed. Areas sown with certified mother seed are eligible for entry into certification. Areas sown with certified commercial seed are not eligible for entry into certification, except in cases where the seed planted has been raised by the entrant (grower) himself. Growers who intend to purchase seed with the object of entering certification must therefore purchase certified mother seed.

LIST OF GROWERS.

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP.		
Mother Seed (Canterbury and Marlborough)—		
Adams Bros., Sheffield (Line A)	2	6
Adams, K. and R., Sheffield (Line A)	3	1
Adams, K. and R., Sheffield (Line B)	3	5
Amor, A. W., Woodend (Line A)	3	1
Amor, A. W., Woodend (Line B)	3	2
Amor, A. W., Woodend (Line C)	2	2
Amyes, H. C., "Riversleigh," Annat	3	2
Anderson, A., Southbridge (Line A)	2	1
Anderson, A., Southbridge (Line B)	3	3
Anderson H. (Estate of), Springston, R.M.D. (Line C)	3	1½
Armstrong, P. L., Fernside, R.D., Rangiora	3	5
Ballantyne's Estate, Fairview, Timaru (Line A)	3	3
Barclay, G. M., Riverlands, Waimate	2	1
Barnett, R., Dunsandel (Line A)	3	5
Barnett, R., Dunsandel (Line B)	3	1
Barr, H. C., Springston, R.D.	3	2
Boyce, W. J., Waituna, Waimate	3	1½
Boyle, A. D., Orari	3	2
Breakwell, A. J., Tinwald (Line A)	3	2
Breakwell, A. J., Tinwald (Line B)	2	2
Brown, G. E., Kaiapoi, R.M.D. (Line A)	2	5
Brown, G. E., Kaiapoi, R.M.D. (Line B)	2	3
Brown, J. L., Washdyke	3	1
Burrell, T. F., Levels	2	1½
Cague, W., St. Andrews	3	1½
Caldwell, G., Courtenay, R.M.D.	2	3
Campion, C. A., Mount Hutt, R.D., Rakaia	3	1
Carroll, F. A., Southbridge	3	2
Carroll, J., Southbridge	1	4
Carroll, T. F., Southbridge	2	4
Chambers, A. J., Carberry, Weedons	3	2
Chambers, W. J., Weedons, Greendale, R.D.	3	2
Chappell, T., West Coast Road, Yaldhurst (Line A)	2	1
Chatterton, C. S., Dunsandel	2	1

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*		
Mother Seed (Canterbury and Marlborough)—continued.		
Cook, P. D., Albury, South Canterbury (Line B) ..	3	1
Couper, R. P., Meadows, Washdyke (Line A)	3	1
Cox, N., 238 Wairarapa Road, Christchurch, N.W. 3 (Line A)	3	2
Cross, A. E., Bennett's, via Rangiora (Line A)	3	1
Cross, A. E., Bennett's, via Rangiora (Line B)	3	2
Cross, H. E., Sandy Knolls	3	1
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line A) ..	2	1½
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line B) ..	3	3
Crump, F., Springston, R.D	3	3
Dale Bros., Maungati, South Canterbury	3	2
Doyle, P. J., Gleniti, Timaru	3	1½
Ellis, M. G., Kingsdown, Timaru	3	1
Ferguson, J. W., Winchmore, R.M.D.	3	4
Foster, J. A., Springston, R.M.D.	3	10
Foster, T. C., Springston, R.M.D.	2	9
Franks, L. J., 88 Russley Road, Christchurch, N.W. 3 (Line A)	2	2
Franks, L. J., 88 Russley Road, Christchurch, N.W. 3 (Line B)	3	2
Gardiner, O. J., Dunsandel, R.M.D.	1	1
Gaskell, L., 112 Russley Road, Christchurch, N.W. 3 ..	1	1
Gilbert, D. R., East Oxford	3	1
Gray, J. L., St. Andrews (Line A)	3	3
Gray, P. B., Hadlow, Tycho, R.D.	3	1
Gray, R., St. Andrews (Line A)	3	2
Guy, T. A. and E. B., Courtenay, R.D.	3	6
Hartnett, T , Rangatira Valley, Temuka . ..	3	1½
Hastie, A. W., Pareora, Timaru (Line A)	3	1½
Hastie, A. W., Pareora, Timaru (Line B)	3	1
Heinisch, A., Springston, R.D	3	1
Henderson, G. H., Courtenay, R.D.	3	2
Hewson, R. H., Seadown, Timaru	3	2
Hill, J., Pareora West	3	1
Hobday, J. H., 33 St. John Street, Christchurch, N.W. 2 (Line A)	3	3
Hobday, J. H., 33 St. John Street, Christchurch, N.W. 2 (Line B)	3	2
Jackman, J., 24 Eversleigh Street, Christchurch, N. 1 .	3	2
Jellie, J., Russley Road, Christchurch	2	3
Johnston, R. H., Dunsandel	3	2
Kavanagh, Mrs. M., 50 Ryan's Road, Upper Riccarton ..	3	10
Kelleher, T., Pleasant Point (Line A)	3	2
Kennedy, L. J , Postman's Road, Kaikoura	3	1
Kenyon, F., Oxford Road, Rangiora	3	3
King and Co., care of G. H. King, West Belt, Rangiora (Line A)	3	3
King and Co., care of G. H. King, West Belt, Rangiora (Line C)	2	1
King, G. H., West Belt, Rangiora (Line A)	3	4
King, G. H., West Belt, Rangiora (Line B)	3	1
King, J. C., Landsboro, Timaru	3	1
King, W. H., Rosewill, R.D., Timaru (Line A)	3	2
King, W. H., Rosewill, R.D., Timaru (Line B)	3	2
Lynch, R., Fairview, Timaru	3	1½
McCaw, W. T., Tycho	3	3
McCullough, S. G., Temuka (Line A)	3	1
McPhail, W., Mitcham, via Rakaia	1	2
Mackle Bros., Kaikoura, Suburban	3	1

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*		
Mother Seed (Canterbury and Marlborough)—continued.		
Marshall, D., Leeston, R.M.D.	3	10
Marshall, S. A., Tycho, R.D., Timaru	3	3
Martin, W. E., Kaiapoi, R.M.D. (Line A)	3	1
Martin, W. E., Kaiapoi, R.M.D. (Line B)	3	11
Moore, H. S., Box 4, Kaiapoi (Line A)	2	3
Moore, H. S., Box 4, Kaiapoi (Line B)	2	2
Morgan, D., Cheviot, R.D.	1	13
Morrison, J. L., Morven	3	2
Mortland, Mrs. S., Templeton	3	6
Mulcock, W. J., 34 Ryan's Road, Christchurch, N.W. 3	3	2
Nicklaus, J. F., 104 Ryan's Road, Christchurch, N.W. 3	2	5
Oakley, H. R., Eiffelton, R.D.	3	3
Oakley, W., Hororata (Line A)	2	4
Oakley, W., Hororata (Line B)	3	13
Oliver, J. O. J., Factory Road, Temuka (Line A)	3	2
Oliver, Mrs. Z. M., Factory Road, Temuka (Line A)	3	1
Parker, F. A., Spring Creek, Blenheim (Line B)	3	1
Pascoe, S., Halkett (Line B)	3	2
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line A)	3	3
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line B)	3	3
Petrie, H. H., Swannanoa, R.D.	3	8
Petrie, J., sen., Swannanoa, R.D.	3	4
Phillips, W., Springston, R.D.	3	1
Porter and Rouse, St. Andrews (Line A)	3	3
Prosser, L. W., Leeston	3	3
Purvis, G., Oxford Road, Rangiora	3	4
Randall, J., Koromiko, Marlborough	3	1
Rangiora High School, Rangiora	3	4
Rathgen, A. E., Leeston, R.D.	3	5
Redmond, C., Kimberley, R.D.	2	15
Rich, A. J., Kaiapoi, R.D.	3	12
Richmond, W. T., Willowbridge (Line A)	3	1
Robinson, R. G., Ltd., Box 4, Papanui	3	4
Rollinson and Sons, Studholme Junction	3	3
Rolston, G., Whincops Road, Halswell	2	4
Roper, P. F., Halkett	2	6
Roper, R. S., Halkett	3	2
Rose, C. F., Hook, South Canterbury	3	2
Ross, A., Washdyke (Line A)	3	1
Ross, A., Washdyke (Line B)	3	2
Royds, R. S., 12 Burnside Road, Christchurch, N.W. 1	3	5
Ruddenklau, J. G., The Valley, Glenavy (Line A)	3	33
Scott, A., Kerrytown, South Canterbury	2	1
Shillito, R. S., 135 Armagh Street, Christchurch, C. 1	3	3
Sievwright, R. M., Meadows, Washdyke	3	4
Simpson, F. F., Morven (Line A)	3	6
Simpson, F. F., Morven (Line B)	3	6
Simpson, F. F., Morven (Line C)	3	3
Smith, E. A., Springston, R.D. (Line A)	3	15
Smith, R. S., St. Andrews (Line A)	3	1½
Smith, R. S., St. Andrews (Line B)	3	1
Steele and Dawson, care of F. Steele, Fernside, Rangiora	2	2
Steele, J., Kimberley	2	3
Stewart, A., Marsh's Road, Templeton (Line A)	3	7
Stewart, A., Marsh's Road, Templeton (Line B)	3	1
Swanson, W., Selwyn	2	2
Tallott, E. D., Cust	2	4
Thomas, J. W., Gray's Road, Christchurch, N.W. 3	3	4

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*		
Mother Seed (Canterbury and Marlborough)—continued.		
Topham, J. W., Arowhenua, Temuka (Line B)	3	1
Tweedy, S., Dunsandel, R.D.	3	4
Upston, E. E., Selwyn	3	2
Walker, C. F. (Estate of), Christchurch, Greendale, R.D.	3	5
Watson, R. G., Cust (Line A)	3	3
Watson, R. G , Cust (Line B)	3	3
Westaway, R. J., Christchurch, Greendale, R.D.	3	14
Whearty Bros., Wheatstone, Ashburton	2	1
Wilson Bros., Halkett, R.D. (Line A)	2	5
Wilson, C. T., Halkett, R.D. (Line A)	3	2
Wilson, C. T., Halkett, R.D. (Line B)	2	3
Wilson, M. G., Springston, R.D.	2	2
Wilson, W. A., Halkett, R.D. (Line B)	3	2
Wilson, W. A., Halkett, R.D. (Line C)	3	2
Wolff, R. G., Horrelville, R.D.	1	3
Wright, L. T., Annat	2	10
Wright, Q. A., Annat	3	8
Mother Seed (Otago and Southland)—		
Miles, A. C. and E., Portobello	3	2
Miller, R , East Taieri (Line A)	3	4
Commercial Seed (Canterbury and Marlborough)—		
Adams Bros., Sheffield (Line B)	4	4
Alexandre, H., Belfast (Line A)	4	1
Alexandre, H., Belfast (Line B)	4	2
Alexandre, H., Belfast (Line C)	5	5
Anderson, H. (Estate of), Springston, R.D. (Line A)	4	2
Anderson, H. (Estate of), Springston, R D. (Line B)	4	2
Bailey, J., Kaiapoi, R.D.	5	5
Ballantyne's Estate, Fairview, Timaru (Line B)	4	5
Barnes, W., and Sons, 199 Highsted Road, Styx, N.W 4	4	2
Bennett, R. R., Eyreton, R.D (Line A)	4	1
Bennett, R. R., Eyreton, R.D. (Line B)	4	3
Berry and Halliburton, 28 Dundas Street, Christchurch, C 1	4	4
Breen, M., Levels (Line A)	4	3
Breen, M., Levels (Line B)	4	1
Campbell, H., Clandeboye	4	1
Carr, J., Mount Hutt, R.D., Rakaia	4	2
Caskey, R., Gleniti, Timaru	4	1
Chapman, N. J., Kaiapoi	5	1
Chappell, T., West Coast Road, Yaldhurst (Line B)	5	1
Cherry Bros., Eyreton-Kaiapoi, R.D. (Line A)	4	1½
Cherry Bros., Eyreton-Kaiapoi, R.D. (Line B)	4	2
Cook, P. D., Albury, South Canterbury (Line A)	5	4
Couper, R. P , Washdyke (Line B)	4	1
Cox, N., 238 Wairarapa Road, Christchurch, N.W. 3 (Line B)	5	1½
Dale, W. S., Kennerley, Temuka	5	2
Dillon, J. G., Courtenay, R.D.	4	4
Dyer, H., Southbrook	6	1½
Eder, T. W., Woodend	6	2
Eder, W., Sefton, R.D (Line B)	5	4
Elder, R. P., 109 Johns Road, Belfast	4	1
Elworthy, P. A., Gordon's Valley, South Canterbury	5	2
Farr, L. E., Bennets	4	4
Frost, C. H., Balcairn Post-office	5	1
Gaffeney, Mrs. M. F., Arowhenua, Temuka	4	3

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*		
Commercial Seed (Canterbury and Marlborough)—continued.		
Gray, J. L., St. Andrews (Line B)	4	9
Gray, R., St. Andrews (Line B)	4	8
Haines, C., 108 Waimak Road, Christchurch, N.W. 4	5	2
Ham, A., Grove Town, Blenheim	4	3
Hayman, T. L. and A. F., Studholme Junction	5	1½
Heer, A. F., Clandeboye	4	1
Hegan, J., and Son, Southbrook (Line A)	6	3
Hegan, J., and Son, Southbrook (Line B)	6	6
Hewson, Mrs. M S., Orari	4	1
Jordan, C. H., Kaiapoi, R.D.	4	2
Jowers, G. C., Springston, R.D.	4	1½
Kelleher, T., Pleasant Point (Line B)	6	6
Kelleher, T., Pleasant Point (Line C)	4	4
King and Co., care of G. H. King, West Belt, Rangiora (Line B)	4	2
McCarthy, E., Prebbleton	4	2
McCullough, S. G., Temuka (Line B)	4	3
McDermott, E. C., 25 Tankerville Street, Christchurch, S.W. 2 (Line A)	5	5
McDermott, E. C., 25 Tankerville Street, Christchurch, S.W. 2 (Line B)	4	2
McGrath, J., Sefton	6	1½
Marshall, W. H., Prebbleton	4	2
Matson, H., and Co., Box 3, Christchurch, C. 1	4	5
Millar, J. E., Killinchy, via Leeston	5	1½
Mills, F. F., Grovetown, Blenheim	4	1
Oliver, J. O. J., Factory Road, Temuka (Line B)	5	2
Oliver, Mrs. Z. M., Factory Road, Temuka (Line B)	5	1
Oliver W. R., Hororata	4	2
O'Loughlin, J. (Estate of), St. Andrews	4	1
Parker, F. A., Spring Creek, Blenheim (Line A)	4	1
Pascoe, S., Halkett (Line A)	6	3
Patterson, A., East Eyreton - Kaiapoi, R.D.	6	5
Payton, J. E., Middle Lincoln Road, Halswell	4	3
Porter and Rouse, St. Andrews (Line B)	4	15
Prebble, R. L., Springston, R.D.	5	8
Proudlock, A., East Eyreton - Kaiapoi, R.D.	6	6
Redmond, W. G., Courtenay, R.D.	4	6
Reynolds, H., Sawyers' Arms Road, Harewood, N.W. 4	4	1
Richmond, W. T., Willowbridge (Line B)	4	1
Robinson, R. P., Waikuku	4	2
Ross, W., Waimate	4	1
Ruddenklau, J. G., The Valley, Glenavy (Line B)	4	13
Saunders, A., Yaldhurst	5	1
Saunders, E. F., Studholme	4	2
Schluter Bros., Rangiora	4	7
Seaton Bros., Courtenay, R.D.	4	4
Seyb, L., Washdyke	6	1
Sharlick, J., Marshlands Road, Ouruhia (Line A)	5	5
Sharlick, J., Marshlands Road, Ouruhia (Line B)	5	5
Shellock, W., Te Pirita, R.D., Rakaia	5	1
Spillane, A., Temuka (Line A)	4	1
Spillane, A., Temuka (Line B)	5	1
Storer, G., Halswell	4	6
Tiffen Bros., Makikihi	5	2
Topham, J. W., Arowhenua, Temuka (Line A)	4	1
Traves, H., Levels	6	1½
Walker, W. H., jun., Halkett, R.M.D.	4	1½

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*		
Commercial Seed (Canterbury and Marlborough)—continued.		
Ward, C. R. T., Ladbrooks (Line A)	6	1½
Ward, C. R. T., Ladbrooks (Line B)	6	1½
Weeber, H., Englefield Road, Belfast, N. 2 (Line A)	5	2
Weeber, H., Englefield Road, Belfast, N. 2 (Line B)	4	9
Weeber, H., Englefield Road, Belfast, N. 2 (Line D)	4	1
Williams, C. M., Box 19, Kaiapoi	4	5
Wilson Bros., Halkett, R.D. (Line B)	4	5
Commercial Seed (Otago and Southland)—		
Miller, R., East Taieri (Line B)	6	2
DAKOTA.		
Mother Seed (Canterbury and Marlborough)—		
Adams, A., Killinchy, via Leeston	4	1½
Allen, A., Killinchy, via Leeston (Line A)	4	16
Allen, A , Killinchy, via Leeston (Line B)	5	8
Ashwell, L., Christchurch-Greendale, R.D.	4	1
Barnes, C. F., Cheviot, R.D.	4	2
Barnett, R., Dunsandel	5	4
Beer, G. F., Horrelville, R.D.	4	4
Bennett, W., North Loburn	4	2
Brown, G. E., Kaiapoi, R.D	4	1
Boyle, W., Springston, R.D.	4	1
Brodie, R., Rangitata Island	5	2
Campbell, D. A., King Street, Rangiora (Line A)	4	2
Campion, C A., Mount Hutt, R.D., Rakaia	4	4
Carr, J., Mount Hutt, R.D., Rakaia	5	6
Chambers, L. J., "Carberry," Weedons, R.D.	5	6
Chambers, R., Rolleston	5	5
Chapman, N. J., Kaiapoi	5	4
Chatterton, W. V., Dunsandel (Line A)	4	1
Cross, A. E., Bennetts, via Rangiora	5	1
Cross, H. E., Sandy Knolls	5	6
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line A)	4	1½
Farmer, F., Springston, R.D.	5	2
Fine, F., and Stead, E. F., care of G. Fine, 57 Springs Road, Sockburn, W. 2	4	4
Foster, T. C., Springston, R.D.	4	7
Fowler, G. H., Halkett, R.D.	4	3
Gardiner, O. J., Dunsandel, R.D.	2	5
Giles, N., Seadown, Timaru	4	3
Goodman, L., Levels	5	1
Hennessey, W., Mitcham, via Rakaia (Line A)	5	1
Hennessey, W., Mitcham, via Rakaia (Line B)	5	1
Hewson, R. H., Seadown, Timaru	4	3
Hill, L. F., Eiffelton. R.D.	4	5
Hooper, R. M., Mitcham, via Rakaia	5	3
Hoskin, S., Doyleston	5	2
Johnston, H. W., Box 12, Dunsandel	2	10
Johnston, R. H., Dunsandel	4	2
Jowers, G. C., Springston, R. D.	5	3
King and Co., care of G. H. King, West Belt, Rangiora	5	19
McCarthy, E., Prebbleton	5	5
McNickol, care of H. S. Stevens, Mount Hutt, R.D., Rakaia	4	2
McPhail, W., Mitcham, via Rakaia	3	14
McRobb, A., Mount Hutt, R.D., Rakaia (Line A)	4	5
McRobb, A., Mount Hutt, R.D., Rakaia (Line B)	5	4
Marshall, D., Leeston, R.D.	4	15

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
DAKOTA—*continued.*		
Mother Seed (Canterbury and Marlborough)—continued.		
Marshall, W. H., Prebbleton (Line A)	5	2
Marshall, W. H., Prebbleton (Line B)	5	2
Minchington, F. W., Fernside, Rangiora	4	1½
Moore, H. S., Box 4, Kaiapoi	5	5
Orbell, W. H., Levels	5	1
Payne, J., Yaldhurst-Courtenay, R.D. (Line B)	5	3
Payne, S., Lincoln	5	3
Petrie, J., sen., Swannanoa	5	5
Prosser, Mrs. M. A., Leeston	5	4
Royds, R. S., 12 Burnside Road, Christchurch, N.W. 1	5	6
Ruddenklau, J. G., The Valley, Glenavy (Line A)	5	8
Ruddenklau, J. G., The Valley, Glenavy (Line B)	5	8
Ruddenklau, J. G., The Valley, Glenavy (Line D)	4	14
Ruddenklau, J. G., The Valley, Glenavy (Line E)	5	6
Ryan, P. F., Weedons-Springs, R.D. (Line A)	5	8
Ryan, P. F., Weedons-Springs, R.D. (Line B)	5	8
Saunders, A., Yaldhurst	5	1
Shellock Bros., Te Pirita, R.D., Rakaia	3	6
Shellock, W., Te Pirita, R.D., Rakaia	3	5
Steele, J., Kimberley	5	1
Stewart, A., Marsh's Road, Templeton (Line A)	5	7
Stewart, A., Marsh's Road, Templeton (Line B)	5	4
Swanson, W., Selwyn	4	3
Thomas, C., Springston, R.D. (Line A)	4	2
Topham, J. W., Arowhenua, Temuka (Line B)	5	1
Tweedy, S., Dunsandel, R.D.	3	11
Walker, C. E. (Estate of), West Melton, R.D.	5	5
Warren, J., Russley Road, Fendalton, Christchurch	5	9
Whearty Bros., Wheatstone, Ashburton	3	1
Wilson, M., Halkett, R.D.	3	5
Wolff, R. G., Horrelville, R.D.	5	7
Commercial Seed (Canterbury and Marlborough)—		
Alexandre, H., Belfast	7	4
Amor, A. W., Woodend (Line B)	6	2
Barnett, G. L., Lakeside	7	2
Benny, G., Southbridge	7	3
Berry and Halliburton, 28 Dundas Street, Christchurch, C. 1	6	6
Boyce, A., Doyleston	6	3
Breakwell, A. J., Tinwald (Line A)	7	3
Breakwell, A. J., Tinwald (Line B)	7	4
Breen, J. and W., Levels	7	2
Burrowes, J., Chertsey (Line A)	6	2
Burrowes, J., Chertsey (Line B)	6	2
Campbell, D. A., King Street, Rangiora (Line B)	6	4
Chambers, A. J., "Carberry," Weedons, R.D.	7	4
Chambers, W. J., "Carberry," Weedons, R.D.	6	7
Cherry Bros., Kaiapoi, R.D.	7	2
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line B)	6	5
Dale, W. S., Kennerley, Temuka	7	1½
Demus, H. F., Geraldine	6	1
Ellmers, J. W., Kaiapoi	7	5
Gardiner, C., care of W. Wilson, Kirwee	7	4
Gerard, C., 40 Plynlimmon Street, Christchurch, N.W. 1	6	1
Gibbs, G., Sawyers Arms Road, Harewood, N.W. 4	7	3
Gill, R. W., Springlands, Blenheim	7	2
Gillman, R. E., Woodend	6	4
Guy, W. V., Rangiora-Springbank, R.D.	7	5

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
DAKOTA—*continued.*		
Commercial Seed (Canterbury and Marlborough)—continued.		
Lambie, R. T., Leeston	7	6
McCartin, J., Leeston	6	8
McKenzie, J., 3 Asylum Road, Christchurch, S.W. 2	6	1½
McLachlan, T. C., Leeston, R.D.	6	10
McCullough, S. G., Rangatira Valley, Temuka	6	3
Mehrtens, J. L., Camside, Rangiora	6	3
Moorhead Bros., Southbridge (Line A)	7	4
Moorhead Bros., Southbridge (Line B)	6	22
Nicklaus, J. F., 104 Ryan's Road, Christchurch, N.W. 3	7	1
Norman, F. J., Springlands, Blenheim (Line A)	7	2
Oakley, W., Hororata	6	3
Pannell, W. B., Rangiora, R.D.	7	6
Parker, F. A., Spring Creek, Blenheim (Line A)	6	4
Parker, F. A., Spring Creek, Blenheim (Line B)	6	4
Payne, J., Yaldhurst-Courtenay, R.D. (Line A)	7	5
Payne, J. L., Lincoln	7	3
Peach, J., Sefton, R.D.	7	2
Petrie, H H., Swannanoa, R.D.	6	2
Phillips, A., Weedons-Springston, R.D	6	10
Phillips, A. G., Weedons-Springston, R.D. (Line A)	6	5
Phillips, A. G., Weedons-Springston, R D. (Line B)	6	1
Phillips, W., Springston, R.D.	6	5
Purvis, R. M., Oxford Road, Rangiora	6	3
Redmond, W. G., Courtenay, R D.	6	4
Reid, G., Woodend Post-office	7	2
Robinson, R. P., Waikuku	7	5
Robson, F. H., Box 22, Lincoln	7	4
Ruddenklau, J. G., The Valley, Glenavy (Line C)	6	20
Schaffer, F. L., Springston, R.D	6	20
Schluter Bros., Rangiora	6	3
Thomas, C., Springston, R.D. (Line B)	6	5
Topham, J. W., Arowhenua, Temuka (Line A)	6	2
Tully, B., Woodend	7	3
Ward, C. R. T., Ladbrooks	6	4
Watson, M. E. M , Dunsandel	6	7
Weeber, H., Englefield Road, Belfast, N. 2	7	1½
White, R. Y., 402 North Road, Styx, N 2	6	1
Williams, J. W., Whincops Road, Halswell, S.W. 2	7	5
Wilson, M. G., Springston, R.D.	7	3
Winter, E. R. V , Brookside (Line A)	7	2
Winter, E. R. V., Brookside (Line B)	7	1
Wright, Q. A., Annat	7	8
ARRAN CHIEF.		
Mother Seed (Canterbury)—		
Barclay, G. M., Riverlands Road, Waimate	4	6
Batchelor, R. S., Waimate	3	1
Boyce, W. J., Waituna, Waimate	4	2
Campbell, P., Studholme Junction	3	4
Connell, M., Arowhenua, Temuka	3	3
Cox, S., Box 9, Willowbridge (Line A)	3	3
Croft, R., " Glenlea," Amberley	4	2
Hayman, T. L. and A. F., Studholme Junction (Line A)	4	2
Henshaw, J. F., Studholme Junction (Line A)	3	2
Lindsay, J., Studholme Junction (Line A)	3	1
Morris, M. J., Willowbridge	3	2
Rollinson and Sons, Studholme Junction (Line A)	3	6
Rollinson and Sons, Studholme Junction (Line B)	3	11

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
ARRAN CHIEF—*continued.*		
Mother Seed (Canterbury)—continued.		
Ruddenklau, J. G., The Valley, Glenavy (Line A)	3	6
Ruddenklau, J. G., The Valley, Glenavy (Line C)	3	2
Ruddenklau, J. G., The Valley, Glenavy (Line D)	4	46
Saunders, E. E., Studholme Junction (Line A)	3	2
Wilson, E. R., Junction Road, Waimate (Line A)	3	3
Wright, L. T., Annat	2	5
Mother Seed (Otago and Southland)—		
Bruce, J. A., Otahuti, R.D., Invercargill (Line A)	4	3
Daly, P. G., Te Wae Wae	4	2
Dobbie, R., Menzies Ferry	3	1½
Forde Bros., Te Tua Post-office	3	1
Griffin, J. G., Te Wae Wae	3	3
Hamilton, G., Tuatapere, R.D.	4	2
Knowler, C. E., Box 97, Tuatapere	4	4
Knowler, H., sen., Te Waewae	2	4
Miller, R., East Taieri (Line B)	4	1½
Orbell, A., Waikouaiti	3	1½
Commercial Seed (Canterbury)—		
Barnes, W., and Son, 199 Highstead Road, Styx, N.W. 4 (Line A)	5	2
Cox, S., Box 9, Willowbridge (Line B)	5	3
Fletcher, W. J., "Hopefields," Willowbridge (Line A)	5	2
Fletcher, W. J., "Hopefields," Willowbridge (Line B)	5	5
Hamilton, A., Lincoln	6	5
Hayman, T. L. and A. F., Studholme Junction (Line A)	7	2
Henshaw, J. F., Studholme Junction (Line B)	6	1½
Henshaw, J. F., Studholme Junction (Line C)	5	5
Kelly, D., Willowbridge	5	4
Lange, C., Willowbridge (Line A)	5	1½
Lange, C., Willowbridge (Line B)	5	2
Leathwick, A., Hunter, R.D., Waimate	7	10
Lindsay, J., Studholme Junction (Line B)	5	1½
Mackenzie, J., 3 Asylum Road, Christchurch, S.W. 2	5	3
Moore, H. S., Box 4, Kaiapoi (Line A)	5	2
Moore, H. S., Box 4, Kaiapoi (Line B)	5	8
Ruddenklau, J. G., The Valley, Glenavy (Line B)	5	8
Saunders, E. E., Studholme Junction (Line B)	5	7
Saunders, F. L., Studholme Junction (Line A)	6	4
Saunders, F. L., Studholme Junction (Line B)	5	4
Smith, W. J. M., Seadown, Timaru	5	2
Storer, G., Halswell	5	1
Topham, J. W., Arowhenua, Temuka	5	5
Wilson, E. R., Junction Road, Waimate (Line B)	5	12
Commercial Seed (Otago and Southland)—		
Anderson, A., Stirling	5	7
Bathgate, A., Outram (Line A)	6	2
Bathgate, P., Outram	5	4
Beckingsale, J. H., Herbert	6	1
Bennett, J., jun., Papatotara, R.D., Tuatapere	5	3
Bruce, J. A., Otahuti, R.D., Invercargill (Line B)	5	1½
Buzan, C. E., Totara, North Otago	5	1
Craig, G. H., Mosgiel	6	1
Graham, J. W., Mosgiel	5	1
Graham, Mrs. K. G., Mataura	5	2
Harvey, W., Mosgiel	5	5

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
ARRAN CHIEF—*continued.*		
***Commercial Seed (Otago and Southland)*—continued.**		
Knowler, H. C., jun., Te Waewae	5	4
Marshall, W., and Son, Outram	5	2
Miller, R., East Taieri (Line A)	5	1
O'Neill, J. J., Kai Ora, R.D., Oamaru	5	1
Sheddan, G. B., Otahuti R.D., Invercargill	6	1
Skinner, J. L., North Taieri	5	1
Weir, J. G., Stirling (Line A)	5	8
Weir, J. G., Stirling (Line B)	6	2
KING EDWARD.		
Mother Seed (Canterbury)—		
Frewn Bros., Waimate	4	1
Penn, T. A., 39 Weston Road, Christchurch, N. 1	4	1½
Ruddenklau, J. G., The Valley, Glenavy	4	5
Saunders, F. L., Studholme Junction	4	1
Sides, J. G., Studholme Junction	4	1
Mother Seed (Otago and Southland)—		
Bennett, J., jun., Tuatapere	2	2
Craig, G. H., Mosgiel (Line A)	4	1
Daly, P. G., Te Waewae	3	1½
Forde Bros., Te Tua Post-office	3	2
Graham, J. W., Mosgiel (Line B)	4	2
Griffin, J. G., Te Waewae	3	2
Hamilton, G., Tuatapere, R.D.	3	4
Heenan, T. D., Maungatua	3	1
Imrie, J. (Estate of), Mosgiel (Line A)	4	2
Knowler, H. C., jun., Te Waewae	2	1
Kokay, S., Tuatapere	3	16
Ledington, F., Lochiel	3	1
Marshall, W., and Sons, Outram	4	2
Milburn, M., Wright's Bush, R.D., Invercargill	2	1½
Miller, R., East Taieri (Line A)	3	2
Ryan, P., and Sons, Gorge Road, Southland	3	2
Scott, A. P., Box 15, Otautau	3	3
Thornton Bros., Momona, Otago	4	3
Thorp, O. R., Te Houka, Balclutha	4	1½
Waite, A., Tapanui	3	1
Wilson, C. H., Lorneville, Invercargill	3	1½
Commercial Seed (Canterbury)—		
Bisdee, J. C., Clandeboye, Temuka	5	1
Guthrie, A., Clandeboye, Temuka	5	1
Commercial Seed (Otago and Southland)—		
Anderson, A., Stirling	6	3
Burgess, D., West Plains, Invercargill	6	2
Craig, G. H., Mosgiel (Line B)	5	1
Graham, J. W., Mosgiel (Line A)	5	2
Hellyer, F., Macandrew Bay, Dunedin	6	1
Imrie, J. (Estate of), Mosgiel (Line B)	5	2
Kenny, J., Mosgiel	5	4
Miller, R., East Taieri (Line B)	5	1½
Skinner, J. L., North Taieri	5	2
South Taieri Young Farmers' Club, Berwick	5	1
Wilkins, Mrs. E. A., Mosgiel (Line A)	5	2

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
ARRAN BANNER.		
Mother Seed (Canterbury)—		
Amyes, H. C., " Riversleigh," Annat, R.D.	4	2
Wright, L. T., Annat	3	5
Mother Seed (Otago and Southland)—		
Craig, G. H., Mosgiel	4	1
Daly, P. G., Te Wae Wae	4	1
Graham, J. W., Mosgiel	4	2
Heenan, T. D., Maungatua	3	3
Knowler, C. E., Box 97, Tuatapere	4	1
Knowler, H., sen., Te Wae Wae	4	1½
Kokay, S., Tuatapere	4	2
Commercial Seed (Canterbury)—		
Bird, A. M., Timaru Road, Waimate	5	4
Leathwick, A., Hunter, R.D., Waimate	6	3
Oakley, W., Hororata	6	6
Simmons, W., Kingsdown, Timaru	6	3
White, R. Y., 402 North Road, Christchurch, N. 2	5	1
Commercial Seed (Otago and Southland)—		
Anderson, A., Stirling	5	2
Bruce, J. A., Otahuti, R.D., Invercargill	5	1
Buzan, C. E., Totara, North Otago	6	1
Carr, C., and Sons, Pukemaori, R.D.	5	1
Harvey, W., Mosgiel	5	3
Hellyer, F., Macandrew Bay, Dunedin	5	1½
Leen, C. R., Kakanui, North Otago	5	1½
Miller, R., East Taieri	5	1
Preen, E. C., Box 25, Oamaru	6	1
Sheddan, G. B., Otahuti, R.D., Invercargill	6	1
Smith, C. R. (Estate of), Bushey, Palmerston	5	2
Weir, J. G., Stirling	6	1
AUCKLANDER TALL TOP.		
Mother Seed (Canterbury)—		
Bailey, J., Kaiapoi, R.D.	2	2
Breakwell, A. J., Tinwald	1	2
Cross, H. E., Sandy Knolls	1	3
Ellis, M. G., Kingsdown, Timaru	2	2
Frost, C. H., Balcairn Post-office	2	5
Guy, T. A. and E. B., Courtenay, R.D.	1	4
Horgan, C., Temuka	2	2
Minchington, F. W., Fernside Post-office	2	3
Roper, R. S., Halkett, R.D.	3	2
Seyb, L., Washdyke	3	1
Simmons, W., Kingsdown, Timaru	2	1
Steele and Dawson, care of F. Steele, Fernside (Line A)	3	7
Steele and Dawson, care of F. Steele, Fernside (Line B)	3	3
Commercial Seed (Canterbury)—		
Frost, S. W., Kaiapoi, R.D.	5	4
Gibbs, G., Sawyers Arms Road, Harewood, Christchurch, N.W. 4	4	2
Judson, C. J., High Street, Rangiora	4	9
Marshall, W. H., Prebbleton	5	1
Reynolds, H., Sawyers Arms Road, Harewood, Christchurch, N.W. 4 (Line A)	4	5

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
EPICURE.		
Mother Seed (Canterbury)—		
Hobday, J. H., 33 St. John Street, Christchurch, N.W. 2	3	3
Macdonald, R., Annat	3	1
Marshall, D., Leeston, R.D.	3	3
Robinson, R. G., Ltd., Box 4, Papanui (Line A)	5	2
Shillito, R. S., 135 Armagh Street, Christchurch, C. 1	3	3
Wright, L. T., Annat	5	2
Commercial Seed (Canterbury and Marlborough)—		
Parker, F. A., Spring Creek, Blenheim	6	1
Robinson, R. G., Ltd., Box 4, Papanui (Line B)	7	2
Commercial Seed (Otago and Southland)—		
Burgess, D., West Plains, Invercargill	6	1
Kirk, R., Tapanui	6	1
EARLY ROSE.		
Mother Seed (Canterbury)—		
Basher, W. F., Walters Road, Marshlands	4	1
Caldwell, G., Courtenay, R.D.	4	2
Church, G. H., Patten Street, Christchurch, N.E. 1	3	1
Commercial Seed (Canterbury and Marlborough)—		
Parker, F. A., Spring Creek, Blenheim	5	1½
Penn, T. A., 39 Weston Road, Christchurch, N. 1	6	1
Shellock Bros., Te Pirita, R.D., Rakaia	5	5
Shellock, W., Te Pirita, R.D., Rakaia	5	1
INVERNESS FAVOURITE.		
Mother Seed (Canterbury)—		
Adams, A. A., Annat	1	1½
Amyes, H. C., "Riversleigh," Annat, R.D.	2	1½
McCarthy, E., Prebbleton	2	5
Macdonald, R., Annat	1	10
Piner, E., Annat, R.D.	1	5
Ruddenklau, J. G., The Valley, Glenavy	2	12
MAJESTIC		
Mother Seed (Canterbury)—		
Caldwell G., Courtenay, R.D.	3	1
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line A)	4	2
Crozier, W. J., Mount Hutt, R.D., Rakaia (Line B)	5	5
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line A)	4	2
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line B)	5	3
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line C)	4	2
EARLY REGENT BOLTER.		
Mother Seed (Canterbury)—		
McLennan, C., Courtenay, R.D.	4	10
Oakley, W., Hororata	2	15
Pascoe, S., Halkett, R.D.	3	9
Wilson, M., Halkett, R.D.	3	1
IRON DUKE.		
Mother Seed (Canterbury)—		
Croft, R., "Glenlea," Amberley (Line A)	5	2
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line A)	5	2
Penn, T. A., 39 Weston Road, Christchurch, N. 1 (Line B)	4	2
Mother Seed (Otago)—		
Heenan, T. D., Maungatua	4	1

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Area in Acres.
JERSEY BENNES.		
Mother Seed (Otago and Southland)—		
Burgess, D., West Plains, Invercargill	4	3
Miller, R., East Taieri (Line C)	3	1
Commercial Seed (Otago and Southland)—		
Hellyer, F., Macandrew Bay, Dunedin	5	1⅛
Kirk, R., Tapanui	5	1
AMERICAN WONDER.		
Mother Seed (Canterbury)—		
Franks, L. J., 88 Russley Road, Christchurch, N.W. 3 ..	3	2
Penn, T. A., 39 Weston Road, Christchurch, N. 1 ..	4	1
Wright, L. T., Annat	3	2
ARRAN CONSUL.		
Mother Seed (Canterbury)—		
Macdonald, R., Annat	5	2
Page, S. T., Sheffield	4	1
Piner, E., Annat	3	1
BRESEES PROLIFIC.		
Commercial Seed (Canterbury)—		
Crawford, R. T., Yaldhurst	6	4
Gallagher, M., Springston, R.D.	6	5
Marshall, D., Leeston, R.D.	6	15
ROBIN ADAIR.		
Commercial Seed (Canterbury)—		
Robinson, R. G., Ltd., Box 4, Papanui (Line A) ..	6	1
Robinson, R. G., Ltd., Box 4, Papanui (Line B) ..	6	1
UP-TO-DATE.		
Mother Seed (Otago)—		
Sanders, W. M., Rockford, Clinton	4	1
Commercial Seed (Canterbury)—		
Steele, J., Kimberley	8	3
BLACK KIDNEY.		
Mother Seed (Canterbury)—		
Robinson, R. G., Ltd., Box 4, Papanui	3	1
GREAT SCOT.		
Mother Seed (Canterbury)—		
Robinson, R. G., Ltd., Box 4, Papanui	3	1
SIR J. G. WILSON.		
Mother Seed (Canterbury)—		
Robinson, R. G., Ltd., Box 4, Papanui	5	1

—*Fields Division.*

The host range of pea-mosaic (previously known to attack peas, broad beans, and red clover) has been extended to include blue lupins, sweet peas, alsike, and subterranean clover. The disease has a very marked effect on time of maturity and yield of garden peas. Two varieties have been found that, up to the present, are immune to the disease.—*Report, Mycologist.*

SEASONAL NOTES.

THE FARM.

Determining advisability of Special Cropping.

SOON, on many farms the major portions of which rightly are in grassland, it will be necessary to decide without further delay what special crops other than grass are to be grown during the current season. It seems likely that at times the area devoted to such special crops is reduced to an undesirable extent because farmers are deterred from growing them on account of estimates of cost of production which are quite misleading. But brief consideration should suffice to make clear the important fact that statements about the cost of production of crops if they profess to cover all items are, in practice, necessarily inaccurate for a great many farms. This is because so few farms replicate exactly in all important respects what is called the " average " farm to which the estimates in theory apply Indeed, the real cost of growing specific crops usually cannot be determined accurately in respect to any individual farms (apart from one-crop farms), and it is unreasonable to expect greater accuracy when a number of farms are grouped for consideration On a strictly academic basis of estimation the cost of special crops usually is made to appear considerable. But, as a rule, much of this cost relates to work done by the labour ordinarily employed and with equipment already provided independently of the special crop. Such expenditure is met whether or not the special crop is grown. Hence the practical question really is largely one of alternative use of land, labour, and equipment: can the land, labour, and equipment be employed more remuneratively than in growing certain special crops. Certainly at times some supplementary outlay on labour and equipment may be advisable if special crops are to be grown, but, as a rule, the major question is largely one of alternative use No general answer can be given to this question: in answering it each farmer must consider his particular circumstances. He must concern himself not so much with the academic cost of a crop, but, among various things, he should determine what will be the direct outlay needed, to what extent the growing of the crop will affect the efficiency of other farm-work, to what extent the special crop is necessary to or conforms with any scheme of pasture-improvement, and in what manner the special crop will influence the returns from all the different kinds of farm-stock being kept. The latter matters are of particular importance—for instance, it may be advisable for one farmer and inadvisable for his neighbour to grow roots for winter feed; improvement of certain pastures of the former may be effected most profitably by way of the plough, whereas the pastures of the latter already may be improved. Similarly the farmers who are endeavouring to exploit fully pig-keeping as a side-line, or who make a feature of raising their own replacement stock, are likely to have greater need of special crops than farmers who are not doing so.

From the above considerations it may be deduced that the advisability of growing special crops cannot be decided upon the basis of cost alone. Indeed, it is ordinarily a complicated matter which cannot be decided lightly. To show, for instance, that a given amount of feed can be provided more cheaply by using permanent pastures than by using special crops does not necessarily enable any reliable decision to be made, for much depends upon when the feed from the different sources becomes available, and how the future production of the farm is affected.

One outstanding fact bears on the position—the feed during the off-seasons of grass-growth is in many cases inadequate, and in a substantial

number of these cases the growing of special crops not only would remedy the position, but also would prove very profitable. In this respect two crops that certainly could be grown more widely with advantage are lucerne and the mangel. Frequently preparatory cultivation for these crops should be commenced at an early date, if it has not already been commenced.

The Value of the Mangel.

The farmers' field competitions, which have been conducted over a wide range of conditions for many years, have provided striking field evidence of the value of the mangel when it receives suitable treatment. During recent years the average yield of some hundreds of crops has been approximately 60 tons an acre: on the basis of their content of nutriment if hay of average quality is worth £3 a ton, then mangels are worth at least 10s. a ton, so that a well-grown acre of mangels is worth £30. Actually, of course, the yield of many crops is much nearer 30 tons an acre than 60 tons. But the field competitions have been useful in showing that, as a rule, there is no essential reason why farmers should be satisfied with such low yields. It is of particular current moment that extensive experience shows not only that success with the mangel is linked with good treatment, but also that early preparatory cultivation is an important part of this good treatment. It has been found that the land devoted to the mangel well may be of the highest possible fertility; hence it is often advisable to dress liberally the future mangel area with farmyard and similar organic manure available from sheds, stack-bottoms, &c. When possible such organic manure should be applied before the land is ploughed; hence the distribution of the organic manure may well be carried out without delay.

Extension of Lucerne-culture desirable.

New Zealand experience in respect to lucerne merely confirms that of other countries by showing definitely that it is misconception to believe that lucerne is particularly exacting in its requirements. This misconception is largely the cause of lucerne not being grown as widely as is warranted by its intrinsic worth. Field experience has shown that lucerne can be grown successfully on practically all types of naturally well-drained soils Deep, open, fertile soils are undoubtedly best for lucerne, which does not reach its maximum production unless both surface-drainage and under-drainage are good. Young lucerne is not capable of battling well against weeds, especially perennial ones—a fact which should be borne in mind in selecting and preparing land for lucerne. This explains why lucerne may well follow old pasture when the land is skim-ploughed well ahead of the time of seeding and subsequently ploughed deeply once only, so that seeds of weeds occurring in the surface layer may be covered with such a depth of soil that they remain dormant provided they are not brought back to the surface layer by later cultivation. Land which recently has been under the plough should be sown in lucerne only if it has been kept " clean " while in the arable condition, either by fallowing or by the growing of fallow crops such as mangels and potatoes which have really cleaned the ground, or by the growing of " smothering " crops such as oats and tares, which weaken weeds. At times, for some obscure reason, the area chosen for lucerne is one of the poorest and one on which no other crops can be grown successfully, with the result, which is not surprising, that the production of the lucerne sometimes is not attractive. Actually lucerne has so many merits that especial care should be taken to select for it not poor unproductive soil, but the most suitable of the soils available. Further information about lucerne is given in this Department's Bulletin No. 155, which is available for free distribution.

Annual Forage Crops.

The value for particular purposes of swedes, carrots, chou moellier, and soft turnips under suitable conditions and management is so well

established that these crops usually should be considered in any cropping programme designed to provide feed during the periods of scant direct supply of feed from permanent pastures.

Tillage for Arable Crops.

Generally in the latter part of June and in July seed-sowing should be avoided, but, as spring oats and wheat usually are sown in August and September and barley in September or early October, it is most advisable in June and July to make all possible progress with the tillage work in preparation for these cereals. However, in July on heavy soils there is often so much water present that tillage would be injurious; injury to the soil may be expected when the soil clings freely to boots or to implements that pass over it, and, when this is so, cultivation, even though it is urgent, should be deferred.

Winter Feeding of Stock.

Poor winter feeding of stock is one of the commonest and most grevious weaknesses in New Zealand farming. The feeding of developing dairy heifers and of hoggets unfortunately often is far below the needs of the animals. Such developing stock are readily susceptible to serious and possibly permanent setbacks as a result of malnutrition in the winter, and the harm which results is likely to be greatly intensified if the stock are infested with internal parasites. The permanent setback may take the form of stunting in size, which experience shows is associated usually with a corresponding stunting in production. Hence it may be expected to prove profitable eventually to give both heifers and hoggets the best feed available. Feeding of straw, poor hay, or stemmy grass-growth is not consistent with this. Feed, such as leafy grass, good hay, roots, and green crops, which is relatively rich in digestible supplies of body-building material is required.

Usually July is a critical month in the feeding of pregnant dairy cows and ewes. During the period when she is not yielding milk the dairy cow should be fed liberally enough to bring about what in Britain aptly has been called a "steaming up" process, which results in recuperation and renewal of bodily reserves, which are particularly likely to be depleted in heavy producers. Feeding that begets this result is considered to assist greatly in warding off udder and other disorders that commonly occur at about calving-time.

New Zealand investigations have demonstrated the importance of good winter-feeding of ewes kept primarily for fat-lamb production; it has been found that the economical production of fat lambs depends to a considerable extent upon obtaining lambs of good weight at birth, and this in turn, as might be expected, is determined by good winter feeding of the ewes.

Field evidence which is being accumulated goes to show that the position in pig-raising is essentially similar; that success with litters and profits from the wintering of stores both depend primarily upon the adequacy of the winter feeding, and that while other matters, such as good housing, may also be essential to success, due attention to these latter matters do not bring success if the feeding is neglected.

The farmer who already has not made provision for the adequate feeding of his stock cannot at this stage do much to remedy the position apart from resorting to purchased feed. But, nevertheless, some good will be achieved by directing attention to the value of good winter feeding at this stage, if it leads to the planning of better supplies of feed for the following winter—a matter which now should be receiving attention.

In the feeding of roots, carrots and mangels should follow swedes in the order given: the mangels may be kept longest because of their particularly good keeping qualities. Chou moellier usually is in good condition for feeding in July, when it generally should be used, for sometimes in August it tends to run to flower-stalks.

Roots and silage may be classed generally as somewhat watery bulky feeds, and so it is better to feed roots and hay than rations of roots alone or of roots and silage. Silage alone has been used at times as a winter supplement to pastures with good results, and this even when very little feed was obtainable from the pastures, but the prolonged feeding of roots alone may lead to disorders such as red-water. Whether better results are obtainable from silage by using it alone or in conjunction with hay in winter is a question about which the evidence available does not allow of a definite answer. Probably much depends upon the respective qualities of the hay and silage ; however, certain farmers feed silage alone successfully, especially at about calving-time, and claim that they thus have less calving trouble than if they had substituted hay for the silage. Similarly silage has been fed successfully to ewes right up to lambing time. A typical satisfactory full-maintenance daily ration for a dry in-calf dairy cow is approximately 40 lb. mangels together with 12 lb. of average hay. When it is remembered that the nutritive equivalent of this ration is 50 lb. of ordinary grass silage, the cause of the tendency towards under-feeding of silage mentioned in these notes last month becomes obvious.

Cereals sown in the autumn should be fed-off before the growth becomes too long ; in general two light feedings of short growth are more satisfactory and involve less waste than one feeding of heavy growth. Autumn-sown green cereals have been used successfully at this stage for pig-grazing when the amount of feed available from the pastures has been undesirably small.

Work with Pastures.

Extensive experience has shown that pasture top-dressing may be carried out with good results during July where it has not been done earlier. Usually it is desirable that such top-dressing bring about additional growth as quickly as possible, and when this is the case then generally superphosphate should be used. Even on somewhat heavy soils in a relatively cold North Island district superphosphate applied in July has produced substantial increases in the amount of feed available in August. It is not to be deduced from this that July is usually the most suitable month for the application of superphosphate : Previously in these notes the application much earlier in the season of superphosphate, as well as of phosphates of somewhat slower effect, has been recommended. But if top-dressing for some reason or another has not yet been done it may still be carried out with potentialities of profitable results.

Under normal conditions the application of nitrogenous manure about mid-July along the lines discussed in these notes last month usually gives a substantial increase in the feed available from the dressed paddocks in August and September. For a few weeks prior to mid-July it is widely advisable not to apply quickly acting nitrogenous fertilizers which act little if at all during the period when pasture-plants are most dormant.

During July harrowing of pastures normally should be carried out : it is particularly advisable on fields which have been stocked heavily with cattle during May and June.

Suitable pastures, preferably well-drained ones provided with shelter, should often be closed up during July for the use later on of early-calving or early-lambing stock. On such paddocks rye-grass is of especial value because of its early growth when the drainage is reasonably good.

An unusually wet winter is often followed by an exceptional abundance on pastures of such weeds as spear-thistles and docks. This points to the desirability of avoiding as much as possible " poaching " or " pugging " of pastures, which creates the bare spots in the sward on which such weeds establish. When a whole farm is wet at least some " pugging " is unavoidable, but attention to the following two rules is likely to assist in minimizing the damage from poaching : firstly, feed out hay and roots on the poorer portions which are likely to be the earliest to be put under

the plough and which will be improved valuably in fertility by such feeding ; secondly, avoid as far as possible the stocking of the most low-lying paddocks.

Pastures which have suffered attacks of the grass-grub, if not so seriously damaged as to call for renewal, usually benefit from having hay and roots fed out on them.

Ensilage.

While one of the features of the farming of the last decade has been the expansion in the area of ensilage, there are still many farms on which it could be introduced or increased with profit. This is particularly true of sheep-farms, but it continues to be widely true also of dairy-farms. Possibly the desirable expansion in ensilage would take place more rapidly were it more generally realized how readily and cheaply suitable trenches or pits may be provided and how greatly they may be made to effect economy of labour and reduce wastage of the material being used. While many farms do not possess suitable locations for pits which are placed most advantageously on small hill-sides, trenches which are really shallow pits can be used efficiently much more commonly than is sometimes believed : trenches excavated on level land are being used widely with full success. Useful information about pits and trenches is contained in this Department's Bulletin No. 146, "Ensilage on the Farm."

Drainage.

This is the recognized time of the year for giving attention to drainage. The fact that the greater part of a drainage system is invisible makes it somewhat difficult to determine whether the system in all its parts is fully efficient in its action ; hence care and thoroughness should characterize drainage work throughout.

At times it may not be practicable to provide thorough under-drainage. When this is so it is well to keep in mind that surface-drainage, which at times can be arranged with relative ease, usually is much better than no drainage.

While improved drainage results in greater returns from the use of suitable fertilizers and high-class seed, it does not follow that because land is poorly drained it should not receive dressings of fertilizer. Indeed in certain circumstances top-dressing of poorly drained land is definitely advisable : high fertility is required for full production of such species as meadow foxtail, *Poa trivialis*, and timothy, plants valuable for conditions so wet that rye-grass and cocksfoot would not tolerate them Top-dressing by raising the fertility to meet the needs of such species will at times prove quite profitable. And, apart from such special cases, top-dressing of somewhat poorly drained land is frequently profitable although it would probably be more profitable with better drainage.

Apart from new drainage work there is at times need in July to do maintenance work to existing drains, which should be inspected regularly to observe how they are functioning. Winter provides good opportunities for determining how future drainage work should be carried out: usually it is easier in winter to obtain knowledge about the fall of the land, &c.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

The Pruning of the Apple.

THE main apple-pruning of the year is carried out during the winter when the tree is dormant. Briefly, the main objects of pruning are—(1) To secure a sturdy, well-formed tree ; (2) to secure regular crops ; (3) to increase the size and quality of the fruit ; (4) to maintain these results over a profitable period.

The main principles which appear to operate in governing the growth of the tree may be summarized as follows : (1) The vigour of the tree is largely determined by its leaf surface ; (2) the nearer a shoot approaches a vertical position the stronger will be its growth, and *vice versa* ; (3) the sap flows most freely to the topmost parts of the tree ; (4) the less the number of buds left upon a shoot the stronger are the resultant growths from each bud ; (5) the fruit-production of the tree is correlated with its vegetative activity, and fruiting increases with decreasing tree-growth and decreases with excessive tree-growth.

The following is a brief statement of the practical application of these facts : —

The leaves of the tree are the food-elaborating organs, or, in other words, the lungs and stomach of the tree. Hence any definite reduction in their number must have the effect of depleting the supply of elaborated food, and must retard to a corresponding extent the growth of the tree. A healthy and adequate leaf surface is necessary for the extension of tree-growth and the production of fruit.

The strongest growth is obtained from vertical shoots, and therefore the vertical shoots are used in building up the framework of the tree, and the more horizontal shoots are utilized for fruit-production.

Unless regulated, the top of the tree produces the most vigorous shoots and absorbs most of the sap to the detriment of the lower portions of the tree.

The harder is the cutting-back of a shoot the stronger is the resultant growth. Hence the harder is the pruning of a tree the more new growth it produces.

As the amount of new growth produced decreases so the fruiting tendency increases : conversely, the stronger a tree is growing the less the tendency to fruit.

Most growers are familiar with the rank-growing tree which fails to produce much fruit, and the more it is cut the more it grows. Of common occurrence is the tree which fails to make new growth and is stagnant, and is prevented by the heavy crops carried from becoming a well-sized tree. Both are extremes to be avoided, and the wise grower endeavours to secure a balanced tree with respect to new growth and fruiting.

The following statements refer mainly to the treatment advised for trees which are already in bearing, the matter relative to the pruning of young trees being an exception to this.

The growth of the tree may be divided as follows : the permanent wood and the temporary wood. The permanent wood consists of the trunk, leaders, and fruiting-arms, and the temporary wood, which is constantly being removed or renewed, consists of all classes of laterals and spurs.

During the first few years the main consideration of the grower should be the building-up of the permanent parts of the tree and the production of a sturdy and well-spaced framework, which in later years is capable of carrying heavy and consistent crops. Fruiting of the young tree is not desirable, as this tends to reduce the vigour of the tree, and, if not controlled, eventually has a stunting effect on all but the trees of strongest growth. The weaker the growth of the tree the longer it should be prevented from fruiting. The tree should be developed first, and fruiting allowed to follow as a natural sequence when a tree of satisfactory size has been secured.

The erect growths, being most vigorous, are those from which the leaders or framework is secured. It is well to remember that a few sturdy and well-spaced leaders are preferable to numerous crowded and spindly leaders.

The pruning of the young trees should encourage vigorous growth of the leaders, and produce a well-formed tree. As the tree grows older overcrowding should be avoided. The centre of the tree should be kept open,

and sufficient space provided between adjacent leaders to allow of the proper development of the laterals which emerge from them. Fruiting-arms should be encouraged on the outside of the leaders, usually two or three per leader being sufficient. These arms should in turn carry laterals, twigs, fruit-spurs, and fruit-buds. The bulk of the fruit should be encouraged to form on the outside of the tree so that it is exposed to an abundance of sunshine and air. The leaders should be grown at an angle of about 40 degrees so that they maintain vigour and are also capable of bearing the complement of fruit and foliage without being bent out of position.

As the tree becomes older the laterals and spurs increase in number, and, unless thinned out, cause overcrowding of the fruiting-wood. With the tree in bearing, consideration turns to treatment of the temporary parts of the tree, the permanent parts having already been satisfactorily formed. The fruit carried on the old and worn-out spurs and laterals is generally of small size, has not the quality of the other fruits, and is more easily affected with russet. Hence the old and effete spurs and laterals should be gradually removed to give place to fresh growth.

The treatment of bearing trees is referred to as refurnishing, and this refurnishing is applied to the temporary parts of the tree Each winter from 12 per cent. to 20 per cent. of the fruiting wood should be renewed, and in each instance the older and more worn-out spurs and laterals should be removed. This type of treatment gives three types of temporary wood: (*a*) The older and useless fruiting wood; (*b*) the young, well-conditioned fruiting wood; (*c*) the new shoots, or annual growths.

The class of laterals and spurs constituting the older and useless fruiting wood should be cut right back to the last bud, with the intention of renewing it. In the case of the young well-conditioned fruiting wood which represents the prospective crop, the laterals and spurs should be thinned and shortened only where necessary to prevent overcrowding. The annual growth of new shoots should not on any account be shortened. When required for future fruiting the young shoots should be left intact, otherwise they should be cut right away to prevent overcrowding. The shortening or cutting in half of these young growths only tends to produce excessive growth, eventually to the detriment of fruiting.

In brief, the desirable tree is a comparatively erect one, with approximately six to eight sturdy leaders, on the outside of which are an average of two fruiting-arms per leader. This permanent wood is well spaced and capable of carrying the weight of the crop. The tree is clothed with the temporary wood, mainly laterals, and also spurs, and there is approximately 15 per cent. of each of one-, two-, three-, four-, five-, and six-year old wood. This temporary wood is well spaced relative to light and air. All diseased and damaged wood should be removed. The refurnishing occupies a six-year cycle, and at no time does excessive cutting occur; therefore in each season the tree-growth is approximately the same—never stagnant, yet, on the other hand, never over-vigorous The heaviest crops consistent with healthy trees may be carried, and crops are produced regularly.

As the treatment recommended is in some respects contrary to that adopted by many, points worthy of note are—(1) Laterals are produced primarily for fruiting; (2) shortening the annual growth induces the production of new extension growth; (3) leaving the annual growth uncut promotes fruit-shoots and bud-development. Therefore the cutting of the laterals promotes excessive new growth in the normal tree, which does not favour fruiting. Hence they should be left uncut, except where they are causing overcrowding, and then each offending lateral should be totally removed and the others allowed to fulfil their normal function—that of producing fruit shoots and buds, and ultimately fruit.

With the different types of tree such as Ballarat, an erect grower, and Jonathan, a willowy type of spreading habit, the pruner needs to exercise care during the formation of the framework. Trees of the more willowy

type need to be carefully pruned to get them to grow erect, and it is usual to prune them to inside buds on the leaders to secure this. Some varieties, such as the Jonathan, naturally produce laterals, and other varieties, such as Dunn's Favourite and Sturmer, are what are termed spur-bearers. It is found a wise practice to encourage laterals to form on all spur-bearing varieties, as far as possible.

The pruning of the bearing tree may be summed up as the gradual thinning-out of the spent fruiting wood and its replacement with fresh growth. It is inadvisable to cut the new growth and leave the old as is so frequently done. The old growth should be pruned away and the fresh growth allowed to develop into fruiting wood. It is advisable to avoid throwing the bearing tree into excessive growth. To revitalize a stagnant tree the procedure should be to reduce drastically the fruiting wood by pruning rather than by severely reducing the head of the tree.

The Pruning of the Pear.

The pruning of pears is not greatly dissimilar from that of apples. Pears, as a general rule, are more prone to become spur-bearers, and some varieties, such as Winter Nelis, are such prolific producers of spurs that frequently fruit-bearing is retarded owing to this over-supply of worn-out and effete buds. A drastic thinning-out of these spurs is required in such cases. As with apples, a thinning-out of the worn-out wood, followed by its replacement with fresh growth, is required. Young laterals should be either left uncut for fruiting, or removed entirely if causing overcrowding. Rational pruning aims at the production of regular and heavy crops, and, if followed, at no time will the tree be thrown into excessive growth, nor will stagnation result. Either of these extremes is the result of a faulty system of pruning.

General.

If the ploughing is not already completed it should be pushed ahead as rapidly as possible and the green crop turned under.

Drainage may be attended to as opportunity offers, as it is desirable that there be adequate drainage to remove the excess moisture and prevent "wet-feet" occurring among the trees. It is also desirable that wet soil conditions do not persist in the spring, when early soil-warmth is desirable and adequate drainage to remove the excessive winter rainfall is of great assistance in fostering warmth.

The working life of tile drains is greatly lengthened if coarse gravel followed by fine gravel is filled directly on to the drain-pipes to a depth of 3 in., the ditch then being filled with earth. Less silting-up of the pipes is likely to result from the use of the gravel.

On wet days the spray outfit, if under cover, may be overhauled. The tractor and other implements should be overhauled on wet days as opportunity offers, and placed in readiness for the next season. Grease on the movable parts and a coat of paint will lengthen the life of all implements, and the cost of this treatment is money well expended. Vexatious delays through faults developing and breakages occurring when the implements are in operation can often be obviated by inspection and overhaul during slack days.

—*R. G. Hamilton, Orchard Instructor, Hamilton.*

Citrus Notes.

Now that the time for the picking of the main crop of lemons is approaching, the need for carefully placing lemons and other citrus fruit in the picking-bag, and for carefully handling them in the transference to the orchard-box, and in the subsequent cartage to the shed, cannot be too strongly emphasized. The orchard-boxes, which should not be filled too full, should be washed to remove possible sources of mould infection after each picking, and carefully examined for protruding nails and splinters

which are likely to cause injury to fruits coming in contact with them and which should be removed. Care in handling is one of the greatest factors in keeping the lemon in sound condition while passing through the various stages of storage until the curing is completed. Pickers should be equipped with gloves so as to eliminate any danger of rupturing the delicate oil-cells on the surface of the skin. When picking the lemon two cuts should be made, the first close up to a matured bud on the lateral and the second directly behind the button on the lemon, as any small portion of stem left hardens in a few days, and in the course of subsequent handling in the curing-shed is a source of injury to other lemons with which the stem comes in contact, with the consequent wastage from blue mould and other rots.

After the lemons have been picked for a few days the outer surface of the skin becomes slightly tougher, but is still very subject to injury, so careful handling should be the slogan right through. Growers, whose attention is drawn to the Local Market Grading Regulations, should so standardize and market their lemons that much of the low-grade fruit which up to the present has been finding its way to the local market becomes entirely eliminated, to the subsequent benefit of all growers of citrus fruit.

The sheds and their surroundings should be kept clean and free of mould-infected fruits. Mould-infected fruits should be handled so as to prevent as far as possible the dissemination of spores in the atmosphere which takes place when mould-infected lemons are thrown into open containers.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Artificial Incubation.

If only one small incubator is to be worked, the question of the place where it is to be operated does not call for much thought, as any quite well-ventilated room suits the purpose, but it is advisable to have the room handy so that the necessary attention can be given easily to the machine.

In countries where great extremes of heat and cold are experienced, special incubator cellars are built, but it is not necessary to go to such expense in this Dominion. However, where a number of kerosene-lamp machines are operated, it is well to bear in mind that the lamps are burning night and day and consuming a large amount of oxygen, and also that from the first week of incubation the growing embryo requires a regular supply of oxygen in order to develop into a strong, healthy, and lively chicken. A mistake is often made of crowding too many machines into one room.

If a stuffiness or strong smell of kerosene is noticed when the incubator-room is entered in the morning, it is a sure sign that more ventilation is required, and, unless the incubator-room is well ventilated and the atmosphere constantly changed by a movement of fresh air, that supply of oxygen so necessary for success is not likely to be available. It is well to make provision for the air to enter the room from below the level of the machines so that a pure supply can pass into the egg-chamber before being contaminated by the fumes from the lamps. Ventilation should also be arranged near the roof so that all impure air may escape. Some troubles experienced during the brooding period may be traced to incorrect ventilation. Farms have been visited where trouble was experienced for several seasons with the rearing of chickens, but after the owners decided to get the hatching done by a more successful incubator-operator they had little trouble in rearing fine flocks of pullets. Such experience indicates that correct incubation has a large bearing on the rearing of the chickens.

Experiments have shown that best results were obtained from kerosene-lamp machines where they were operated in a room giving at least 2 cubic feet of air-space for each egg undergoing incubation.

While ample ventilation is necessary, care must be taken to see that no direct draught is allowed on the lamp, as this may cause smoking and perhaps fire. As correct even temperature during the incubation period is a very important factor in successful incubation, it is well to see that the sun's rays do not strike through the window directly on to the machine, as such rays are likely to cause variations which should be avoided. The jarring of the eggs, which may be caused by the slamming of doors or the bumping of the machine, should be guarded against. The chief points of good incubation are the keeping of a fairly even temperature in the room, quietness, and good ventilation.

The Incubator.

It is not the cost of the incubator that counts so much as the cost of the eggs that are placed in it. It is wise, therefore, to avoid cheap or second-hand machines of unknown make. There are, of course, many good, second-hand, reliable incubators, especially since a number of poultry-keepers have installed large mammoth machines, but the beginner should guard against the risk of starting off with incubators of unknown efficiency just because they can be procured for a few shillings less than dependable ones. Many very disappointing results have been due to this.

If the desirable conditions for the eggs are not provided in the room or incubator during the period of incubation, only the very strongest germs hatch, and even then those that do hatch under unsatisfactory conditions can hardly be expected to turn out as well as those hatched under the best conditions.

How to start an Incubator.

Every maker sends out with each incubator a set of instructions as to the setting-up and working of it, and, as he is anxious that the best results should be obtained, his instructions should be followed carefully, as he is the best qualified to advise.

It is essential to set the machine level in order that the temperature is as even as possible throughout the egg-chamber. If the incubator has been used previously it should be given a good overhaul before the season starts. Hot water and soda should be run through the pipes. The interior of the egg-chamber should be fumigated between each hatch. This can be done by placing a small quantity of Condy's fluid mixed with a small quantity of formalin on a saucer in the machine, and closing the door for a couple of hours.

Thermometers should be tested before starting operations each season. This can be done by placing a clinical thermometer and that to be tested in a basin of hot water, about 100° F. It has been found that some thermometers may register correctly one year but may be a degree out, or even more, the next year. If no clinical thermometer is on hand the local chemist will no doubt oblige by doing the testing.

Soft or rain water should always be used to fill the pipes in water machines, as hard or spring water is more likely to have a bad effect on pipes and solder. The machine should be heated up slowly and allowed to run empty for a day or two, or at least until it has been properly regulated.

Eggs for Incubation.

Eggs for incubation should be as fresh as possible, for seldom do eggs over ten days old give satisfactory results.

During the early part of the season, especially during very cold weather, it is advisable to collect eggs twice a day, and when eggs are held for incubation purposes it is well to cover them at night in order to protect them against frost. Only those of a good shape, size, colour, and texture of shell should be set. Very large eggs seldom hatch well, and it is not wise to set eggs under 2 oz. in weight. When placing them in the machine it is advisable to see that the air-cell is slightly higher. Better results are

secured if the egg-trays are not overcrowded, and on no account should eggs be heaped on top of one another. Experience has shown that the best results are obtained when machines are run a little below their full capacity. The eggs should be heated up slowly, for if heated up too quickly broken yolks may result. Especially is this so when incubating duck-eggs.

Turning of Eggs.

After placing eggs in the machine, do not disturb them for at least thirty-six hours, and then it is well to turn them once each day during the first week of incubation and twice each day from then on until the eighteenth day. The object of turning the eggs is to prevent the yolk from settling down towards the shell, and to give the developing embryo exercise and a fresh feeding-ground. It is not necessary for each egg to be turned exactly over, so long as each egg is moved gently. As all parts of the egg-chamber are not always at the same temperature, by moving the eggs about and turning the trays better results are obtained. However, it is essential that eggs be handled gently, as jarring or rough handling often causes crippled or deformed chickens.

Cooling of Eggs.

The time that should be allowed for cooling depends upon the season of the year and the stage of incubation. During the first week about the time it takes to turn them will be sufficient cooling, and then two or three minutes extra each day should be about enough. If it takes more than an hour and a half to bring the eggs back to the required heat, less cooling should be given. Do not allow the eggs to get cold but return them to the machine while just luke warm.

Moisture.

Generally speaking better results and stronger chickens are obtained when moisture is applied at some period during incubation, but just when and how much should be applied at all seasons of the year and in all localities it is impossible to say. The maker's instructions should be carefully followed regarding this matter. It is a good plan to set a hen at the same time as the incubator, and if a comparison between the incubator and naturally hatched eggs is made, and the air-cell watched, much may be learned. The flow of air through the egg-chamber and the humidity of the air affects the amount of evaporation. It is only by experience that the correct amount of ventilation and moisture can be determined.

It is a good plan to keep a record of the working of each machine. If a record of such matters as the temperature at morning, noon, and night, when and how the ventilators are worked, when moisture is applied, and how long the eggs are cooled were kept one would soon learn how best to operate the incubator in any particular district.

It is just as well not to change the regulator too often, but as the embryo develops heat is thrown off and slight changes are required. Incubators are not difficult to work, and, as in most phases of poultry-culture, if the small details are attended to most of the up-to-date incubators give satisfactory results.

--C. J. C. Cussen, Chief Poultry Instructor, Wellington.

THE APIARY.

Moving of Bees.

At this season of the year bees may be moved with perfect safety to a new location. If the work is left until spring, when the activities of the hive commence, the resultant loss of field bees will be enormous. More especially should advantage be taken of the bees' dormant condition if the hives are to be moved short distances only. The colonies are numerically weaker,

and there is usually little brood to become injured in transport. When hives are located for any length of time in one position the flying bees take full observation of every landmark, but as in the winter there are shorter periods of sunshine the flight of the bees is necessarily curtailed, and they usually return at a much shorter distance from the hive. In addition there are often periods of several days together during which they take no flight at all, and in consequence they must renew their acquaintance with their surroundings when an opportunity for flight occurs. Therefore if the hives are moved during a spell of bad weather the bees will take more readily to their new location when a fine day comes. Any bee-shifting operations should be completed before the end of July.

To secure bees for transit over a short distance sufficient ventilation can be provided by tacking a piece of wire gauze over the hive-entrance. It is then necessary only to secure the bottom and roof, and after making sure that there are no holes through which the bees can escape the hive may be carried with perfect safety.

The successful moving of bees over long distances calls for considerable preparation. All heavy combs should be secured, and only sufficient honey left in the hives to prevent the bees from starving during their journey. The most important factor is ventilation, and it is the neglect of this matter which leads, as a rule, to heavy losses when bees are being moved. The constant vibration of any vehicle tends to disturb the cluster, and the excitement caused thereby is sufficient to raise the temperature of the hive considerably, so that the bees are in danger of being suffocated and the brood scalded. These troubles can be avoided by the employment of wire screens. First see that the frames are made as secure as possible by inserting two wedges between the side of the hive and the top of the end frames. This prevents the frames from rocking during transit. The bottom-board should then be secured to the hive-body by means of crate-staples, driving one end of the staple into the hive-body and the other into the bottom-board. Usually six staples are sufficient. The screens can be made by using narrow laths nailed together to form a frame of the same dimensions as the hive-body, and covering this with wire cloth, such as is used for making queen-cages. The screens must be securely fastened to the top of the hive and the entrance covered with wire cloth. By this means ample ventilation is provided to ensure the safe carriage of the bees during the winter months.

In these days of motor transport the work of moving bees over long distances is greatly minimized, and the beekeeper is well advised to adopt this means if it can be obtained. In any case the beekeeper who has occasion to move bees should not relax any effort to make the hives secure when moving to a new location.

Dry Mats.

At intervals during the winter months the mats should be examined to note their condition. After heavy rain the mats are liable to become damp. Damp mats should be replaced by dry ones. To save delay a supply of dry mats should always be kept on hand. As far as possible, do not disturb the colonies when making an examination, and especially avoid jarring the hives. The roof can be carefully lifted and the mat examined. If the latter has to be removed see that the smoker is handy in case the bees are troublesome, but do not use smoke unless the bees have to be driven down. Remove the wet mat as speedily as possible, replace it with a dry one, and cover the hive.

Leaky Covers.

In cases where damp mats are found they usually point to defects in the covers, and it should be worth the beekeeper's while to remove these also. At all seasons the comfort of the bees should be one of the main considerations, and this factor cannot be ignored if successful wintering is to be expected. The labour involved in keeping the hives watertight repays

itself many times over, and prevents to a large extent the loss of heat generated by the bees. The beekeeper should aim at reducing the waste of energy of the bees by maintaining the heat of the cluster at an even temperature during the unproductive season, and this will be impossible where leaky roofs are tolerated. Successful wintering is a high test of the beekeeper's capabilities.

Permanent Shelter.

Now that the actual work of the apiary is off the beekeeper's hands for a while he may devote his attention to the matter of providing permanent shelter for the hives. If he has definitely decided on a permanent location for the apiary he should now set about the cultivation of a hedge of quick growth. This matter is a most important one, and ranks next to that of locality. It is noticeable in sheltered situations that the bees are able to take cleansing flights during the mild days of winter, whereas bees in unsheltered positions are often confined to their hives even on sunny days. An occasional flight in the winter is as necessary for the welfare of the bees as any provision the beekeeper can make for their comfort. In addition to protecting the bees during the winter months from stormy winds, an occasional flight is an incentive to increased brood-rearing in the spring and early summer.

Whatever shrubs or trees are provided for the purpose of producing a permanent hedge, they should be planted thickly and trimmed to produce abundant foliage, especially at the base. It is highly important that the plants are able to stand cutting back, so that the hedge can be kept at a reasonable height. Hedges grown to a height of 8 ft. to 10 ft., and no higher, will provide ample shelter for a large apiary, and there will be less trouble in taking swarms if the trees are kept to the height indicated. Location and situation must to a large extent influence the beekeeper in choosing the most suitable plants, but, whatever the hedge, the idea should be to form thick shelter and not to form a plantation.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Seed-sowing.

In the warmer districts the new season commences during the month of July with the sowing of early crops outside so soon as a good seed-bed is available. A good seed-bed consists of a soil friable not merely on the surface, but to the full depth of the cultivation, suitably enriched with manures, and free from weeds. For sowing it is important that the soil be sufficiently dry to run freely.

With the object of now completing the preparation of land for seed-sowing, weed-seeds near the surface should be allowed to sprout, after which the plants may be destroyed readily by shallow hoeing in fine weather. The cultivation must be shallow to avoid bringing more weed-seeds to the surface. Where a generous application of farm manure, or green crop, and bonedust have been turned under it probably will be sufficient to broadcast and work in an ounce of superphosphate per square yard (nearly 3 cwt. per acre). Where the land is light a dressing of sulphate of potash very well may be included at a rate of rather less than an ounce to the square yard. Where manure has not been applied, the amount of these fertilizers may be at least doubled and a dressing of sulphate of ammonia included ; in which case it is important on acid soils to be sure that the lime-requirement of the soil is supplied adequately, or the best results will not be obtained from these fertilizers.

A common mistake is to sow cheap seeds, and these much too thickly, thus greatly increasing the labour and producing an inferior crop. All expensive seeds are not good, but they usually are if obtained from a reputable firm which specializes in the class of supplies. Good seeds sown at a fraction of the usual rate will require little or no thinning and produce a superior crop at a much less cost. The parsnip is one of the few crops that are generally not over-sown. The supplies of potato-seed were, not long since, very unsatisfactory, but since the institution of the system of Government-certified seed the position has much improved. In the warmer districts especially, only certified seed should be sown, as the ravages of virus disease are much more rapid under such conditions, and local seed-stocks quickly deteriorate.

Where new land has been broken in and a fine tilth cannot be obtained, the smaller seeds cannot be sown over large areas; but in some instances plants may be raised in specially prepared beds for planting out. These beds require careful preparation, and, after sowing, a thin layer of sand or well-sieved thoroughly decayed manure spread over the surface will prevent the soil forming a hard crust and allow the seedlings to come through. Where satisfactory drainage under all conditions cannot be obtained, the crop should be grown on raised beds.

Vegetable Crops.

As winter crops of cabbage, cauliflower, broccoli, &c., are harvested, clear the land and prepare it for further cropping. Keep a sharp lookout for club-root disease and burn all infected material. Take the first opportunity when the land is sufficiently dry to hoe the weeds in crops of young spring cabbage and cauliflower; follow this up with a moderate dressing of nitrate or ammonia so soon as growth commences. If much nitrogen is required the addition of a little potash also will be an advantage at this period.

Established plantations of asparagus should now be cleaned up and given a dressing of manure and kainit, if it has not already been done. Rhubarb may be given a dressing of manure and superphosphate. Where new plantations of rhubarb are to be made, plant now a well-coloured variety in land that is clean and has received a generous dressing of manure, setting the crowns 2 in. below the surface, 2 ft. apart, and 3 ft. between the rows. Where asparagus is to be planted out during the month of August the preparation of the land should now be completed. Where this crop is to be planted out twelve months hence, a sowing should now be made so that, by providing a long growing season, strong plants will be available. Ample seed should be sown so that all weak plants may be discarded and only strong crowns planted out. Sow the seeds 2 in. to 3 in. deep, and sufficiently thinly to produce plants 3 in. to 4 in. apart, with 18 in. between the rows for large sowings.

Towards the end of the month of July plant out cabbage and cauliflowers, shallots and garlic, artichokes and, where temperatures are suitable, early potatoes. Especially on light land, sow onions, early turnips, shorthorn carrots, peas, radish, lettuce, and spinach; also broad beans. Sowing and planting should be done only where the preparation of the land has been completed and the soil is sufficiently dry; otherwise sowing and planting are better deferred until the conditions are right.

In warm districts tomato-plants are sometimes set out in unheated glasshouses towards the end of July, and in some cases this may be warranted, but usually the latter part of August is sufficiently early where artificial heating is not provided. An average soil and atmospheric temperature of about 55° F. is required at planting-time; and when the plants are established

a little ventilation should be given when the weather conditions are favourable. In preparation for planting the soil and subsoil should be made thoroughly wet by watering the land three or four weeks before planting is done. The plants should be set deeply without bringing the soil round the stem of the plant above the previous soil-level at which it was grown; the depression gradually is filled in later in the process of cultivation. When the house is planted each plant should be settled into position with water that is slightly warm. Distance between plants is most important: It should not be less than 12 in apart and 24 in. between rows; 30 in. between rows is more desirable, especially in warm localities and where means for ventilation are inclined to be deficient.

Small and Sundry Fruits and Nuts.

There are trees and shrubs suited to almost every situation—in the garden, orchard, or paddock—for shade, shelter, ornament, and fruit. On flat alluvial land an avenue of walnuts set in well-proportioned spaces is a satisfying feature in more than one respect, while sweet chestnut on warm hilly country is not excelled for shade, timber, and good crops of nuts that are excellent when used as a vegetable. Almost every property is a separate problem in that the soil, climate, and contour vary; the selection of plants and their arrangement should be well thought out. Planting should then be done under good conditions so soon as convenient now and not later than the end of September in most instances.

For small fruits planted in beds or brakes the best preparation of the land is necessary, and specially must the ground be cleared of perennial weeds: further suggestions in this matter are given in the April number of the *Journal*. In the colder districts where strawberry-planting is done in the spring, it is best done now so soon as the soil is in condition as is the planting of all hardy fruiting deciduous shrub plants Passion-vines, tree-tomatoes, and Cape gooseberries are best planted in the month of October. In cold districts evergreen plants of this class may be planted towards the end of August or during the month of September. The pruning notes under the heading of the Homestead Garden in the May number of this *Journal* should be applied to young plants mentioned above after they have been planted out.

In established brakes of small fruits pruning should now be completed and prunings burnt, to destroy the larvæ of the clear-wing moth (*Sesia tipuliformis*), which commonly burrows the twigs and branches of currant and gooseberry bushes, as well as other pests which can to some extent be controlled by taking this precaution. Green crops between the rows or manures should now be carefully ploughed under. Avoid going more deeply than 6 in., or the plants will suffer owing to injury to their roots.

The Homestead Garden.

Alterations to established gardens or the laying-out of new ones should now be pushed along in order that they may be completed during the months of August or September.

In established gardens portions of the lawn where the turf is worn thin may be removed to a depth of about 2 in. and neatly replaced by fine turf of a similar character. Where the verge of a lawn has spread, cut it back true to the line, and where it is worn back from the verge carefully lift the turf and bring it forward, filling the space which is thus formed with new turf. On light land especially, a lawn is greatly improved now by applying a thin top-dressing of rich compost finely screened. In some cases lawns have been rather overcrowded with specimen trees and shrubs which destroy the restful character of the green and make the grass more difficult to cut; these may now be removed and the places turfed over. In the shrubbery

border new features may be introduced to give it character, improve the sky-line, or add brightness at certain seasons. This can be done readily now after giving the matter a little careful consideration. The foreground especially often requires a little adjustment in planting dwarf shrubs rather closely to cover the ground and hide the base of the taller plants at the back: azaleas, heaths, daphne, and, in exposed situations particularly, some of the dwarfer native veronicas are very suitable for this purpose. Herbaceous borders also may now be replanted when the land is in suitable condition.

Where a new garden is being made the cleaning and cultivation of the land should now be completed so soon as possible so that the soil has time to consolidate before planting and sowing down lawns. The height and grading of the surface requires careful consideration to obtain the best effect. The surface should always fall slightly from the dwelling outwards; if the natural contour of the land rises, as it frequently does in hilly country, at the back of a house, the outward fall may terminate in a water-table, which should be thoroughly well drained. Planting may be done so soon as the newly cultivated land has settled, and the plants should be pruned as described in this section of the May *Journal*. Land which is to be sown in grass should be hoed occasionally to destroy seedling weeds, and allowed to consolidate ready for sowing during the months of August or September.

—*W. C. Hyde, Horticulturist, Wellington.*

SEED-WHEAT CERTIFICATION.

CERTIFIED CROPS.

UNDER the Government scheme for the certification of seed-wheat, the following growers have seed from crops which have passed both field and grain inspections. (Previous lists, to which purchasers are also referred, were published in the March, April, and May issues of the *Journal*.)

Variety.	Grower.	Acreage.
Cross 7	R. C. Bean, Waiau	20
	*Mrs. E. Frizzell, Swannanoa	40
	Gardiner Bros., Upper Waitohi, Temuka	8
	*J. J. Hall, Otaio	10
	*J. A. McLeod, Tycho, Timaru ..	15
	*H. Richards, Box 78, Methven ..	8
Dreadnought ..	J. Forsyth, Willowbridge	10
	Government Pure Seed Station, Box 4, Lincoln	1
	*G. F. Sides, Studholme Junction ..	8¼
Hunters II ..	*W. Bloomfield, Maerewhenua, via Oamaru	14
	G. Brown, Stirling	11
	*H. Evans, Upper Plain, Masterton ..	10
	*J. D. Wills, Tai Tapu	6
Solid Straw Tuscan	Mrs. B. Galletly, St. Andrews ..	10
	Gardiner Bros., Upper Waitohi, Temuka	25
	F. E. Morrish, Springston R.D. ..	4
	J. L. Morrison, Morven	25

* Passed subject to machine-dressing.

—*Fields Division.*

WEATHER RECORDS: MAY, 1936.

Dominion Meteorological Office.

NOTES FOR MAY.

ONE of the most notable south-westerly storms in the history of the country occurred on the 2nd May, and the weather remained wet and rather stormy until after the close of the first week. Thereafter there occurred a spell of settled weather, unprecedented for the time of year. From the 8th until the end of the month no considerable disturbance affected the Dominion. There was very little wind, but what there was came mainly from a southerly direction. Frosts and morning fogs were numerous; but there were many fine days, and conditions were never really severe. On the whole, little growth occurred in vegetation, and in certain districts pastures have been depleted. On the other hand, feed has in some cases been hardened and its nourishing properties consequently increased. In the principal dairying districts the milk-yield has fallen away, but stock are reported everywhere to be doing well.

Rainfall.—In parts of Central Otago and much of Southland, where there was a good deal of showery weather, the rainfall was above the average. Elsewhere the month was an extraordinarily dry one. The North Island had only about 60 per cent. of the normal fall, many places recording only about a quarter. Similar conditions prevailed in Nelson, Marlborough, and Canterbury.

Temperatures.—Temperatures were, in general, between two and three degrees below normal, making the month one of the coldest Mays on record. In parts of the interior of Canterbury and in the far South, however, the normal temperature was exceeded. Some hard frosts were experienced, especially in the north-central portions of the North Island.

Sunshine.—A good deal of cloud occurred in eastern areas in what was otherwise fine weather, but the great majority of places had considerably more than the average amount of bright sunshine

Pressure Systems—At the beginning of the month a deep cyclone was centred near Chatham Islands Several secondary depressions moved into this from the west, each bringing lower pressure to the Dominion. The culmination came with the last of these, on the 2nd. Pressure was extraordinarily low over the whole New Zealand area and severe south-westerly gales were responsible for damage from one end to the other of the country. The weather was very cold, with frequent heavy showers, and, in many places, hail. Snow fell on the high levels, and a number of violent thunderstorms were experienced. A storm of such violence over so great an area has probably not previously been recorded in the Dominion.

On the 3rd pressure rose and the weather improved. The westerly type of weather continued to prevail, however, until the 7th. Conditions remained unsettled, with intermittent rain During the 6th and 7th, there was practically general rain, with heavy falls in the ranges and western districts from Taranaki southwards. The 7th brought a southerly change and snow, again, on the high country.

From the 8th until the end of the month the air pressure throughout was frequently very high and fell below 30 in. for brief intervals o ly. The one causing the depression which involved the greatest fall of pressure passed on the 29th, and was followed by rather colder weather and a little snow again fell on some of the ranges. Generally speaking, however, the amount of snow on the mountains decreased during the month, and at the end there was less than usual at this time of year.

During the period between the 22nd and the 28th, scattered rains were recorded on most days in North Auckland, but the effect of the storms was much less than might have been expected.

Such rain as did occur after the 8th was very erratic in its incidence and frequently of a very local character.

RAINFALLS FOR MAY, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
			North Island.			
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	1·86	10	0·66	6·61	24·27	21·57
Russell	3·03	11	0·57	7·07	54·15	20·84
Whangarei	2·11	12	0·72	7·88	34·66	25·06
Auckland	1·26	7	0·25	5·15	22·62	18·84
Hamilton	1·22	7	0·38	4·70	25·74	18·79
Rotorua	1·38	8	0·60	5·69	32·51	21·62
Kawhia	3·33	7	1·55	5·34	24·77	19·82
New Plymouth	2·03	9	1·22	6·20	25·00	22·59
Riversdale, Inglewood	3·80	12	2·23	9·69	40·37	38·38
Whangamomona	2·74	5	1·05	6·84	32·67	27·81
Hawera	1·94	10	0·52	4·58	20·17	16·98
Tairua	1·66	6	0·68	7·08	28·62	26·59
Tauranga	1·73	7	0·54	5·10	30·11	21·53
Maraehako Station, Opotiki	0·85	8	0·44	5·70	31·27	22·13
Gisborne	2·81	17	0·52	5·36	26·32	20·01
Taupo	0·73	6	0·36	3·95	23·63	16·80
Napier	1·89	9	0·66	3·18	27·74	13·16
Hastings	0·98	9	0·41	3·29	25·48	13·56
Whakarara Station	1·74	7	0·55	..	31·93	..
Taihape	2·25	12	0·54	3·46	22·81	14·43
Masterton	5·05	14	0·85	4·04	25·18	15·18
Patea	2·14	10	0·53	4·15	21·96	17·16
Wanganui	1·60	7	0·58	3·34	20·25	14·33
Foxton	0·95	8	0·30	3·19	18·92	11·88
Wellington	2·87	13	0·99	4·10	24·08	16·58
			South Island.			
Westport	4·61	11	1·51	8·35	24·91	37·65
Greymouth	3·78	9	1·37	8·10	29·93	40·76
Hokitika	4·55	10	1·83	9·58	29·46	45·87
Ross	5·40	11	2·75	9·83	35·75	54·04
Arthur's Pass	7·88	8	5·45	12·78	40·53	65·41
Okuru, South Westland	7·90	10	2·30	10·80	54·08	61·32
Collingwood	4·62	6	2·45	8·87	31·55	34·80
Nelson	1·02	4	0·54	3·26	12·31	14·81
Spring Creek, Blenheim	0·76	6	0·37	3·03	15·09	11·53
Seddon	0·44	5	0·31	2·83	13·22	10·23
Hanmer Springs	2·59	9	1·02	4·54	27·77	18·38
Highfield, Waiau	1·28	7	0·47	3·25	21·63	14·27
Gore Bay	1·88	6	0·58	3·41	19·31	13·18
Christchurch	1·36	11	0·52	2·62	18·48	10·10
Timaru	0·35	5	0·14	1·48	15·78	9·39
Lambrook Station, Fairlie	..	..	..	1·57	..	10·12
Benmore Station, Clearburn	0·61	6	0·25	1·79	8·50	10·99
Oamaru	0·50	5	0·20	1·60	14·10	9·00
Queenstown	3·14	8	0·95	2·59	14·54	13·13
Clyde	1·39	7	0·46	0·99	5·83	6·84
Dunedin	2·09	8	0·68	3·15	19·98	14·94
Wendon	2·31	12	0·50	1·98	13·96	12·89
Balclutha	3·12	13	0·75	1·92	12·40	10·72
Invercargill	4·36	26	1·10	4·36	18·39	19·67
Puysegur Point	5·38	18	1·12	6·67	34·07	35·67
Half-moon Bay	4·28	20	1·14	4·85	17·39	24·22

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MANAGEMENT OF PIGS ON DAIRY FARMS.

A SURVEY OF SOME MANAGEMENT FACTORS INFLUENCING THE RETURNS FROM PIG-FATTENING ON DAIRY FARMS

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A FARM survey covering the production of pig-meat from dairy farms was commenced by the Manawatu-Oroua Pig Development and Recording Club in 1932-33, and has been continued during the succeeding seasons. The object of the survey was primarily to ascertain the practical possibilities of pig-production in association with dairying under ordinary farm conditions.

The results of the 1932-33 season(1) indicated that the production of 40 lb. of pig-meat (dressed weight) was not only practicable but in accord with the average results of farms employing reasonable management methods. It was also clear that the expression of returns from pig-raising in terms of the output of flesh per 100 lb of butterfat provided a convenient and effective means of measuring the efficiency of pig-production on such farms It was further evident that additional information, covering a larger number of farms, was necessary to give a more precise measure of the influence of certain factors indicated to be of importance in securing high pig returns Wide differences in efficiency were apparent between individual farms, it is not sufficient merely to attribute such differences to "management", rather it is the details of management which are important and upon which there is a definite need for reliable information.

While it is recognized that it is impossible, with the facilities available and with the use of the survey method alone, to investigate fully the many and interacting factors which may be broadly classified under the head of "management," it was hoped to obtain information on certain major aspects which possibly affect returns

Throughout the survey the work covered a very much larger number of farms than those actually included in this analysis Many records had to be discarded owing to lack of essential information, due not to any fault of the farmers who co-operated in the work and to whom the Club gives thanks, but to the fact that many dairymen are too fully occupied with other duties to keep accurate records of the data required For the same reason the survey was of necessity confined to the collection of major details only, and many points which are essential for a reasonable study of pig-management could not be examined

SUMMARY OF RESULTS.

The following results cover the three years' records and include approximately fifty farms :—

Table 1.—Gross Production of Farms.

Year	Number of Farms.	Number of Cows.	Number of Acres.	Total Butterfat.	Total Pig-flesh.
				lb.	lb.
1932–33 ..	11	755	1,142	180,230	62,968
1933–34 ..	29	1,434	2,565	402,207	162,332
1934–35 ..	14	641	1,230	173,746	80,375
Total ..	54	2,830	4,937	756,283	305,675

Table 2.—Average Production of Pig-flesh.

Year	Pig-flesh per 100 lb. of Butterfat.	Pig-flesh per Cow.	Pig-flesh per Acre.	Calves reared per 1,000 lb. of Butterfat.	Meals used per 100 lb. of Meat.	*Cash †Returns per Pound of Butterfat.	
						Gross.	Net.
	lb.	lb.	lb.	lb.	lb.	d.	d.
1932–33 ..	34·9	83·4	55·1	0·1	14	1·4	1·35
1933–34 ..	40·35	113·2	63·3	0·08	30	1·6	1·47
1934–35 ..	46·4	125·4	65·3	0·07	42	1·85	1·64
Totals ..	40·4	108	62	0·08	29·8	1·62	1·49

* Cash returns based on pig-flesh at 4d. per pound. † Net cash returns based on gross returns less cost of all meals used at £9 per ton.

	Pig-flesh. lb.
Highest yield per 100 lb. butterfat	72·3
Lowest yield per 100 lb. butterfat	21·5
Highest yield per cow	206·2
Lowest yield per cow	54·7
Highest yield per acre	164·9
Lowest yield per acre	30·5

Highest ratio of sows to dairy cows—1 : 4·5 ; yield in pig-flesh per acre = 60·2 lb.
Lowest ratio of sows to cows—1 : 18·0 ; yield in pig-flesh per acre = 30·5 lb.
‡Highest cash return per pound of butterfat—Gross, 2·9d. ; net, 2·13d.
‡Lowest cash return per pound of butterfat—Gross, 0·9d. ; net, 0·8d.
‡Highest cash return per cow—Gross, £3 8s. 9d. ; net, £2 13s.
‡Lowest cash return per cow—Gross, 18s. 7d. ; net, 15s.

Consideration of the above figures indicates—

(*a*) That the average level of efficiency on the farms covered has increased each year from 34·9 lb. of flesh in 1933 to 46·3 lb. of flesh per 100 lb. of butterfat in 1935.

(*b*) That the increase in yield has been accompanied by an increase in the quantity of meals used to supplement dairy by-products.

(*c*) That the increase in yield has been accompanied by an increase in the cash returns per pound of butterfat, after paying for the meals used.

(*d*) That there is a marked variation in the efficiency of pig-production on different farms.

The highest farm, with an output of 72·3 lb. of flesh per 100 lb. of butterfat, £3 8s. 9d. per cow, and 2·9d. per pound of butterfat, is more than three times as efficient as the lowest farm, with an output of only 21·5 lb. flesh per 100 lb. of butterfat, 18s. 7d. per cow, and 0·9d. per pound of butterfat.

‡ All cash returns based on 4d. per pound for pig-flesh and £9 per ton for meal.

The high average level of production achieved by the fifty-four farms is extremely satisfactory in providing a guide to what is possible, and reflects considerable credit upon the individual farms concerned. Over 20 per cent. of the farms show an output of 50 lb. of flesh and over per 100 lb. of fat, while only 11 per cent. fell below 30 lb. per 100 lb. of butterfat.

Although this level of production (40·4 lb. per 100 lb. of butterfat) is more than double the Dominion average, and although the farmers considered are thus making far more effective use of their dairy by-products than the majority of their fellow-farmers, the conditions and methods employed are in no degree elaborate or involved. Indeed, it may be stated safely that the housing, equipment, stock, and general methods of feeding and management fail to reach to standards advocated by the recording clubs of the Dominion In other words, the production has been obtained at little overhead cost, and the cash return figures given in Table 2 are virtually the net cash returns obtained from pig-raising on these farms.

In view of this, the opinion of the recording officer, who was closely in touch with the farms concerned in the course of collection of the figures, as to the major reason for the good results obtained is worthy of attention : " That if any reason can be given in general terms for the relatively high level of production obtained, it lies in the fact that the individual farmers concerned have, as a whole, a greater personal interest in pig-raising and a better realization of its possibilities as a supplementary source of revenue on the dairy-farm than has the majority of farmers This ' interest ' is reflected in more efficient all-round management, but has in no way involved undue overhead costs in the form of elaborate equipment, expensive stock, or increased labour requirements "

FACTORS IN PIG-MANAGEMENT CONTRIBUTING TO HIGH PRODUCTION.

Examining the records of the whole fifty-four farms on a basis of the output per 100 lb. of butterfat, it is possible to obtain some information on several of the broader aspects of pig-management which may exert an influence on returns. In the following table the farms are grouped according to the production per 100 lb. of butterfat :—

Table 3 – Farms grouped according to the Output of Pig-flesh per 100 lb Butterfat.

Group Flesh per 100 lb Butter-fat	Number of Farms in each Group	Average Flesh per 100 lb Butter-fat	Sow-Cow Ratio	Number of Pigs reared per Sow	Pigs bought	Type of Trade: Bacon	Type of Trade: Pork	Type of Trade: Weaner	Meal used per 100 lb Meat	Cash Returns per Pound of Butterfat: Gross	Cash Returns per Pound of Butterfat: Net.
		lb	1		Per Cent	Per Cent.*	Per Cent *	Per Cent *	Per Cent.	d	d
60 +	3	68·0	5·4	15·8	2·7	6·7	87·8	5·4	84·5	2 72	2·1
50–55	8	53·5	7·1	13 7	2·6	39·2	54·9	5·9	48·9	2 14	1·86
45–50	9	47·1	7·5	13·2	0·9	24·7	60·6	14·7	32·5	1·88	1·71
40–45	12	41·8	9·5	12·5	9·1	43·4	40·2	16·4	24 1	1 67	1·56
35–40	9	38·3	11·0	12·6	6·4	37·0	61·3	1 7	40·5	1·53	1·36
30–35	7	32·0	11·4	8·3	22·8	51·2	41·5	7·3	16 5	1·28	1·22
30 -	6	25·9	12·7	8·6	18·7	60·1	38·3	1·6	7 2	1 04	1 02
Fifty-four farms		40·4	10·0	12·3	7·4	37·7	53·2	9·1	29·8	1 62	1·49

* Percentage of total output on weight basis.

From Table 3 it would appear that three factors are associated with high yields of pig-flesh per 100 lb. of butterfat :—

(*a*) A high ratio of breeding-sows to dairy cows.

(*b*) Efficient sow-management, as indicated by the number of pigs reared annually per sow.

(*c*) The use of meals in reasonable quantities to supplement separated milk.

The influence of the type of trade upon the production of pig-flesh is not so clear, though the figures suggest that concentration upon the production of pigs of light weights—porkers and weaners—is associated with higher yields than is the production of pigs of heavier weights—baconers. The avoidance of purchasing pigs for fattening appears to be the policy of farmers producing at a high level of efficiency.

From the economy or cash-return viewpoint, the advantage of high outputs per 100 lb. of butterfat is obvious, both higher gross and net returns per pound of butterfat resulting from high yields. It is also of interest not only that the use of meals is associated with high yields, but also that the net cash returns after paying for the cost of meal increase with higher levels of meal-consumption.

THE IMPORTANCE OF THE SOW-COW RATIO AND EFFICIENT SOW MANAGEMENT.

It will be clear that the significance of the sow-cow ratio figures in Table 3 is dependent upon (*a*) the number of pigs reared per sow, (*b*) the number of pigs purchased, and (*c*) the type of trade. Two farms may have the same balance of sows to cows, but the two farms may not be comparable owing to a difference in the efficiency of sow-management leading to differences in the number of pigs reared per sow. Similarly, a low sow-cow ratio may be compensated for by the purchase of pigs for fattening. Again, owing to the fact that a bacon pig is approximately twice the weight of a pork pig when marketed, the same output of flesh could be obtained with only half the number of sows under bacon-production as under pork-production, assuming the same number of pigs to be reared per sow.

To obtain a more definite indication as to the relative influence of different ratios of breeding-sows to cows, it is thus necessary to take these three factors into consideration. This can be done by calculating the " effective sow-cow ratio " for each farm by adjusting the actual ratio, the actual number of pigs reared per sow, and the number of pigs purchased per sow, to a standard of fourteen pigs reared annually per sow. The influence of type of trade can be allowed for by examining the farms on a basis of those producing above and those producing below certain levels of bacon-production.

This has been done in Table 4A and Table 4B (next page), where the farms are grouped according to the " effective sow-cow ratio," and show the relative productive efficiency per 100 lb. of butterfat for different ratios.

PRODUCTIVE EFFICIENCY : EFFECTIVE SOW-COW RATIO.

The expression " effective sow-cow ratio " combines the effect of the actual sow-cow ratio and the efficiency of sow-management as

well as taking into account pigs purchased. It will be seen from the tables that both on farms where pork-production predominated and where bacon-production predominated the maintenance of a reasonable balance between sows and cows, together with good sow-management, is essential to the attainment of a reasonably efficient yield of meat per 100 lb. of butterfat.

Table 4A.—Farms producing under 50 per Cent Bacon.

Group Range: Sow-cow Ratio	Number of Farms	Average Ratio Sows to Cows	Average Yield Pig flesh per 100 lb. of Butterfat
1 :			lb
4·5 to 6·5	11	1 : 5·6	55·4
6·6 to 8·5	11	1 : 7·5	43·4
8·6 to 10·5	8	1 : 9·8	40·0
10·6 and over ..	6	1 : 13·0	31·3

Table 4B.—Farms producing over 50 per Cent Bacon.

Group Range: Sow-cow Ratio.	Number of Farms.	Average Ratio Sows to Cows	Average Yield Pig-flesh per 100 lb of Butterfat
1 :			lb
8·0 to 12·0	6	1 : 10·1	46·3
13·0 to 16·0	7	1 : 15·4	34·1
18 and over	5	1 : 27	26·3

The most efficient farms in both groups—*i.e.*, pork and bacon—are those with a high "effective sow-cow ratio," or, in other words, farms carrying from 1 sow to 5 to 7 dairy cows, and rearing fourteen pigs per annum per sow, in the case of predominantly pork-farms, and from 1 sow to 10 to 12 dairy cows, rearing fourteen pigs per sow, in the case of predominantly bacon-farms.

It must be emphasized at this stage that, while it is undoubtedly essential to carry a fair proportion of breeding-sows to dairy cows if high yields are desired, it is possible to carry this aspect to extremes. A high balance between sows and cows necessitates a corresponding efficiency in general management. The dangers of overstocking in this connection are very real, and, from observations, are quite an important factor contributing to the disappointing returns of many farmers Examination of the individual records of the farms show that in the group carrying from 1 sow to 4·5 to 6·5 cows, the production varied from 70 lb. of flesh to 44 lb. per 100 lb. of butterfat. On the other hand, good management in other respects may compensate for low efficiency in respect to number and management of sows, as illustrated by the very fair return of 42 lb. of flesh per 100 lb. of butterfat from one farm carrying only 1 sow to 11 cows, and producing mostly pork.

While the general situation is certainly as shown in Table 4A and Table 4B, and a sufficient number of pigs must be available to utilize the separated milk produced, this is only the preliminary stage in the raising of pigs, and it must be accompanied by comparable efficiency in other respects if high returns are to be obtained.

The Influence of Supplementary Meals upon the Efficiency and Economy of Production.

From Table 2 and Table 3 there is an indication that the use of supplementary meals along with the dairy by-product has been associated with both more efficient and more economic returns. This aspect of management is further examined in Table 5, in which the farms are compared on a basis of varying levels of meal supplementing per 100 lb. of meat produced.

Table 5.—Productive Efficiency: Use of Supplementary Meals

Group: *Meal per 100 lb. Flesh	Number of Farms.	Average Meal used per 100 lb Flesh.	Yield of Flesh per 100 lb. of Butterfat.	Range of Yield of Flesh per 100 lb of Butterfat	Cash Returns per Pound of Butterfat	
					Gross	Net.
		lb	lb		d.	d
No meal	8	Nil	36·1	47·9–23·9	1·45	1·45
Up to 20 lb.	18	11·4	39·1	50·9–22·0	1·56	1·51
21 lb. to 60 lb.	10	35·7	45·1	52·2–40·1	1·80	1·63
60 lb. to 100 lb.	9	79·5	54·5	72·3–43·8	2·18	1·72

* The meal covers all meals purchased and home-grown, the latter also being charged for at the same rate as the former—viz., £9 per ton. Flesh is valued at 4d. per pound.

Table 5 provides interesting confirmation of the tendency already exhibited for high results to be associated with the use of a certain amount of supplementary food. It will be noted that, in the group using only an average of 11·4 lb. per 100 lb. of meat produced, there is an increase in output of flesh, though not materially greater than that of the no-meal farms. The group using the highest quantity of meal has by far the highest output of flesh.

On a cash-return basis it will be observed that in each group the net-return figure increases with the increase in the amount of meal used. In this connection it must be observed that actually the bulk of the meal used was grown on the farms concerned, and that even bought meal is charged for at a higher price than actually was paid in many cases. It is obviously essential, however, for comparative purposes to charge for home-grown fodder, and to adopt a flat rate for the purpose.

Just as in the previous section, dealing with sow-cow ratio, management in respect to other factors is of considerable importance. The mere provision of meal will not of itself produce high returns or economic returns. In this connection the column in Table 5 showing the individual range of farm production shows how on some farms using very little meal good results were obtained, while on others, using relatively larger quantities, the output was not at a particularly high level. It is significant, however, that both the maximum and minimum range of production increase as the amount of meal increases.

It is also worthy of note that on no farm is the quantity of supplementary food at a particularly high level, ranging to a maximum of only 1 lb. per pound of meat produced. That the use of from 50 lb. to 100 lb. of meal per 100 lb. of flesh is profitable is also in accord with the results of meal-feeding trials of the club, which indicate from ½ lb. to 1 lb. of meal per 100 lb. live-weight per day to be profitable in fattening at average prices for meals and for pork and bacon.

It should also be noted that on farms using meals to supplement separated milk it was not the general policy to use them right through from birth to slaughter; rather was their use confined to the feeding of (*a*) the nursing-sow, (*b*) the sucker during the pre-weaning stage, (*c*) the weaner for a few weeks after weaning, and (*d*) the fattening pig only when milk-supplies were inadequate. On farms wintering store pigs meals were also used during this stage. It is suggested that the use of the meals in this way—essentially during the early rather than the later stages of growth, and also during periods of milk-shortage—was a contributing factor to the success obtained on the profit side. Controlled investigations into the problem of the economic use of meals, as well as theoretical considerations, show that these relatively expensive foods will return a greater profit when used during the early stage of growth, for the reason that as the pig increases in weight more food is required to produce a pound of weight gain.

Practically every farm used roots of one or more varieties—mangels carrots, swedes, potatoes—to supplement the rations of sows and other pigs during the winter period. It is impossible, however, to estimate accurately the quantities so employed. In addition, grass provided the bulk of the dry sows ration on most farms, while the young pigs also had access to pasture during part of their fattening period. The adequate provision of supplements of these types was a characteristic feature of farms securing the best returns.

THE INFLUENCE OF TYPE OF TRADE.

In view of the possibility of future expansion of pig products being of necessity along lines of bacon-production rather than of pork-production, it is desirable that more definite information should be available upon all aspects of these two types of trade

At the present time the majority of farmers concentrate upon pork-production, using a limited output of pigs of bacon weight to cope more effectively with the seasonal fluctuations in their milk-supplies. This situation is illustrated in Table 3 from the average results, more pork and light weaner store pigs being produced than baconers by the farms under examination. Actually only six farms of the fifty-four produced over 75 per cent. of the total output in the form of bacon carcasses.

From the point of view of efficiency of production, theoretical considerations, as mentioned in the first report(1), suggest that there should be little difference between porker-production on the one hand and baconer trade on the other so far as relative output per 100 lb. of butterfat is concerned. The heavier food-requirement per pound of flesh produced after the porker stage is compensated for by the heavier sow overhead of porker-production. It is equally evident, however, due to the seasonal nature of milk-supplies and the usual farrowing months of breeding-sows, that porker-production is an easier task than baconer-production from the point of view of general management. Late litters meet a falling milk-supply, while it is difficult to fatten any of the second litters born in the summer-autumn period to the bacon stage without considerable reliance upon supplementary feed. It is undoubtedly for this reason that many of the farms in this survey fail to farrow all their sows twice annually, farrowing only a proportion during the summer-autumn period.

So far as the farms covered in this survey are concerned, the following table sets out the position according to the level of bacon-production :—

Table 6.—Productive Efficiency : Type of Trade.

Group : According to Percentage of Bacon produced.	Number of Farms.	Average Flesh per 100 lb. of Butterfat	Range of Flesh per 100 lb. of Butterfat.	Sow-Cow Ratio.	Pigs reared per Sow.	Meal per 100 lb. of Flesh.	*Cash returns per Pound of Butterfat. Gross.	Net.
		lb.	lb.	1 :		lb.	d.	d.
Nil ..	10	44·4	69–37	7·8	13·7	37	1·78	1·60
1 to 25 ..	7	45·7	72–23	8·3	13·0	42	1·83	1·62
25 to 50 ..	19	42·6	56–33	8·2	12·8	20	1·70	1·61
50 to 75 ..	11	38·1	52–23	12·0	10·6	39	1·52	1·36
75 to 100 ..	6	35·9	52–22	12·0	8·9	50	1·44	1·25

* The cash returns are based on the same price for pork and bacon—4d per pound During the period covered pork prices have been invariably higher by 1d per pound than bacon, a fact which makes the situation even more in favour of the pork trade.

From Table 6 it seems that there is little significant difference between farms producing from nil to 50 per cent. of bacon so far as efficiency per 100 lb. of butterfat is concerned. Even in the case of farms producing over 50 per cent. bacon, there is little difference, though what does exist is in favour of pork-production. Examination of the column showing the pigs reared per sow in conjunction with the production per 100 lb. of butterfat would suggest that part at least of the lower production of the bacon-producing groups in comparison with the pork-producing ones is due to inferior sow-management rather than to the bacon-production itself.

In this latter connection a comparison between the proportion of sows farrowed only once a year in the pork groups and the bacon groups is of interest. In the groups producing from 0 per cent. to 50 per cent. bacon only 3 per cent. of sows farrow only once annually, while in the groups producing from 50 per cent. to 100 per cent. bacon 26 per cent. farrow once only. This largely accounts for the low number of pigs reared per sow.

If, as suggested in the introduction to this section, the policy of failing to farrow a proportion of the breeding-sows during the summer-autumn period is a characteristic of present methods of bacon-producing farms, then the lower efficiency of sow-management on such farms cannot legitimately be advanced as a reason for the lower output of such farms, and the lower production figures shown by the bacon groups must be considered characteristic under present conditions of management. The position calls for investigation of the most efficient farrowing-times for breeding-sows producing pigs for bacon-production.

The figures supply more definite evidence than hitherto available upon which to base recommendations in respect to desirable ratio of sows to cows for the two types of trade. Thus examination of Table 4A and Table 4B would suggest that, under good management conditions in other respects, a ratio of 1 sow to 5 to 7 dairy cows is suitable for high yields under a predominantly pork type of trade, and 1 sow to 10 to 12 cows under a predominantly bacon type of trade.

THE IMPORTANCE OF HOME BREEDING.

If the average standard of efficiency of 40 lb. of pig-meat per 100 lb. of butterfat obtained by the fifty-four farms under review can be considered a better performance than the average, the manner in which the pigs used for fattening were obtained is worthy of attention, in view of the alternative methods of home breeding and buying-in available to all farmers.

Table 1 suggests that high results are obtained in association with the avoidance of buying-in. In examining the records of the individual farms it is perhaps significant that 62 per cent. reared all the pigs they required for fattening, 50 per cent. reared more than they required as shown by the number sold as weaners to be fattened by other farmers, 38 per cent. bred insufficient animals and were forced to purchase part of their requirements, while only 16 per cent. purchased more than 10 per cent. of the number of pigs they sold.

Of the latter, the following table shows the relative production :—

Table 7.—Production of Farms purchasing 10 per Cent and upwards of their Requirements of Pig Numbers.

Number of Farms	Percentage of Purchased Pigs	Yield per 100 lb of Butterfat	Sow-Cow Ratio	Pigs reared per Sow.
		lb		
4	20	33·1	1 9·7	9·0
6	40	30·0	1 12·0	7·6

Carrying a wide ratio of sows to cows, combined with poor sow-management, these farms have been forced to buy pigs to cope with milk-supplies. From observation of the methods of such farms several factors in part or together contribute to the generally lower level of efficiency :—

(*a*) Purchased pigs frequently bring disease which affects not only the thrift of the bought-in animals, but very often that of the home-bred pigs as well.

(*b*) Owing to the price factor, purchases are seldom made when actually required according to milk-supplies, and the number handled frequently falls below that possible. The net result is a wastage of separated milk.

(*c*) Economy of food-consumption decreases with increase in the size of the pig. The purchasing farmer loses the economy of the weaner stage, and, in addition, frequently makes matters worse by growing his purchased animals to very heavy weights in order to recover his original cash outlay.

(*d*) On such farms the farmer regards the pig more as a means of eliminating a waste product—skim milk—rather than as a profitable source of revenue. This attitude is reflected in general management methods with resultant effect upon production.

In reference to the first point, that of disease, the experience of three farms, whose low results of 28·3 lb., 22·9 lb., and 21·5 lb. are definitely attributable largely to losses through disease, may be mentioned in illustration. These farms purchased 47 per cent., 42 per cent., and 25 per cent. of their requirements of pigs respectively. Disease of a parasitic nature was introduced, and as a

result up to 25 per cent. of the purchased animals died, the rate of growth and grading quality of the remainder was affected, and the trouble was transmitted to the home-bred pigs as well.

THE INFLUENCE OF MONTH OF FARROWING OF BREEDING-SOWS.

Since pig-raising in association with dairying involves efficient utilization of separated milk, and since supplies of this food which forms and must continue to form the bulk of the ration are seasonal in nature, it is obvious that really efficient utilization requires a planned adjustment of pig numbers and sizes to milk-supplies. Such a balance between milk-supplies and food-requirements of the pigs necessitates in its turn the organization of sow-farrowing to produce pigs in the numbers and at the times required.

Previous examination of this aspect of pig-management by the writers suggest that early farrowing, commencing before the herd comes into profit, and a distributed farrowing, extending over two or three months, is likely to give the best results. Particularly is this important, for reasons already given, in respect to bacon-production.

During the 1934–35 season an endeavour was made to collect data of farrow dates. This was successful in the case of twelve farms, all producing at a good level of efficiency and all producing mostly pork. While the number is insufficient upon which to base any conclusions, the results are of interest in lending support to the suggestion that early farrowing and planned farrowing are helpful to good results :—

Four farms farrowing—
First litters May, June, July } Averaged 55·2 lb. of flesh
Second litters Nov., Dec., Jan. } per 100 lb. butterfat.

Four farms farrowing—
First litters July, Aug., Sept. } Averaged 48·8 lb. of flesh
Second litters Jan., Feb., Mar. } per 100 lb. butterfat.

Four farms farrowing—
First litters Aug., Sept., Oct. } Averaged 43·5 lb. of flesh
Second litters Jan., Feb., Mar. } per 100 lb. butterfat.

OTHER GENERAL MANAGEMENT FACTORS.

While the data available are insufficient to obtain information upon more detailed aspects of management for the reasons already given, the opinion of the recording officer, based upon close observation of the farms concerned and a wide practical experience of pig-raising under dairying conditions, is worthy of attention. In addition to the points already mentioned, he considers the following factors to have played a part in the general high average of the fifty-four farms as a whole, and of the extremely satisfactory figures of the more efficient units :—

(*a*) Good-quality breeding-stock : Many of the breeding-sows have themselves been under the test of official litter-recording, and many others have been selected on a basis of litter-recording work from proven strains.

(*b*) A definite policy on the part of the farmer in respect to all his pig operations.

(c) Consistent and regular feeding from birth to slaughter.
(d) The marketing of pigs at definite weights, rather than marketing when milk-supplies suit.
(e) Reasonable housing and equipment, providing warmth and comfort for both breeding-stock and growing pigs at all times.
(f) The reduction of mortality to a minimum by reasonable care of the sow at farrowing-time, reasonable cleanliness in quarters and in feeding-equipment, and other simple precautions.

SUMMARY.

The foregoing presents an outline of the results obtained from the survey of pig-production on Manawatu dairy-farms, and indicates—

(1) That a standard of 40 lb. of pig-flesh per 100 lb. of butterfat is obtainable from pig-raising on home-separation dairy-farms under reasonable management conditions.
(2) That this can be secured with reasonable management by running a ratio of 1 breeding-sow to 5 to 7 dairy cows when pork is the major product, and 1 sow to 10 to 12 cows when bacon is the major product.
(3) That fourteen pigs per sow should be reared annually for really efficient results ; a high sow-cow ratio together with efficient sow-management is essential for high yields.
(4) That the use of supplementary meals along with separated milk is helpful in the securing of high yields, and such use is economic when combined with good management : at the rate of from ½ lb. to 1 lb. of meal per pound of meat produced.
(5) That there is little difference on an efficiency basis between pork and bacon production ; pork-production gives slightly better results under present methods of production , pork-production combined with a proportion of bacon-production offers greater ease of management than either alone.
(6) That home-breeding is associated with more efficient results than purchasing.
(7) That a planned policy of farrowing-periods for breeding-stock is a characteristic of the policy of the most efficient farms ; that early farrowing rather than late seems associated with high yields.

The data contained in the foregoing report was collected by Mr. W. J. Croucher, formerly recording officer of the club. Thanks are due to Mr. E. P. Nielsen, present recording officer, for assistance in the classification of the data, and to Professor Riddet for advice and criticism in the preparation of this paper. The thanks of the club are also due to the many farmers who readily made their farms, their books, and records available to the club, and to the New Zealand Meat Producers' Board, whose financial assistance to the club has made the work possible.

REFERENCE.

(1) RIDDET and MCMEEKAN: Returns from Pig-fattening on Dairy-farms. *N.Z. Jour. Agr.*, February, 1934.

PREVENTION OF STORAGE WASTAGE IN COX'S ORANGE PIPPIN APPLES.

RESULTS OF COLD-STORAGE INVESTIGATIONS.

R. SUTHERLAND, Cool Storage Officer, Horticulture Division, Department of Agriculture, Wellington.

DURING the past four years (1932–35) a series of investigations into the cause of wastage in Cox's Orange Pippin apples was carried out in co-operation with the Department of Scientific and Industrial Research and the New Zealand Fruit-export Control Board.

The definition of the word "wastage" used in this report means deterioration which renders apples inedible, causes loss, or reduces their market value.

As almost every season some loss in Cox's Orange Pippin apples from bitter-pit, internal breakdown, and fungal rotting is reported in shipments at their destination overseas, a series of experiments was designed to test the influence on these diseases of a number of factors obtaining in the export of this variety of apple. The examinations of the fruit were arranged in such a manner as to reproduce conditions comparable with shipment, transport, and distribution of the apples at their respective destinations in the United Kingdom.

The apples concerned in the trials were obtained from orchardists engaged in the export trade; the fruit was wrapped, packed, and forwarded to cold storage at Wellington through the usual channels as for export. The examinations of the experimental fruit were made each season at times coinciding with the arrival of a shipment of Cox's Orange Pippins at an overseas destination and subsequent marketing.

In this manner the influence of the following factors on the incidence of wastage was tested, and the results obtained will be discussed under their respective headings: (*a*) Locality and soil types; (*b*) maturity at the time of picking; (*c*) transport temperatures; (*d*) wrap treatments; and (*e*) types of packs.

LOCALITY AND SOIL TYPES.

The Cox's Orange Pippins involved in the trial to test the influence on locality and soil types on wastage were obtained from five localities and from two types of soil (clay and sandy) in each locality. The terms "clay" and "sandy" soils applied to them may not in every case possess the characteristics which would be attributed to them in any system of soil classification, and therefore the terms merely indicate the heavy and light soil obtaining in each locality.

For this experiment the samples were taken from the first commercial picking, but complete uniformity was not adopted in gathering the fruit; consequently some of the samples were gathered more forward in maturity than others, the result being less bitter-pit in the more mature fruit at the expense of increased internal breakdown and fungal rotting.

In some instances, however, there was evidence that the stage of maturity at which the samples were gathered was not the sole cause of fungal rotting, and although it is well known that orchard hygiene

is very important in the production of clean fruit, packing-house sanitation is equally as important in preventing fungal rotting. Cleanliness of the packing house and plant is essential. All culls and decayed fruit should be removed from the interior and exterior of the packing-sheds. The machinery, bins, and the floor should be thoroughly cleaned once daily. Earth floors in packing-houses are a source of fungus infection, particularly where decayed fruit has been dropped and has been allowed to be tramped into the soil. The spores may be discharged into the atmosphere, lodge on the fruit, and become active when the conditions are suitable for their germination

In agreement with the results of the split consignments carried out during the 1928 and 1929 seasons, except for bitter-pit, wastage was negligible at the time the samples were removed from cold storage. It was not until they had been exposed to air at atmospheric temperatures that fungal rotting began to increase to any appreciable amount.

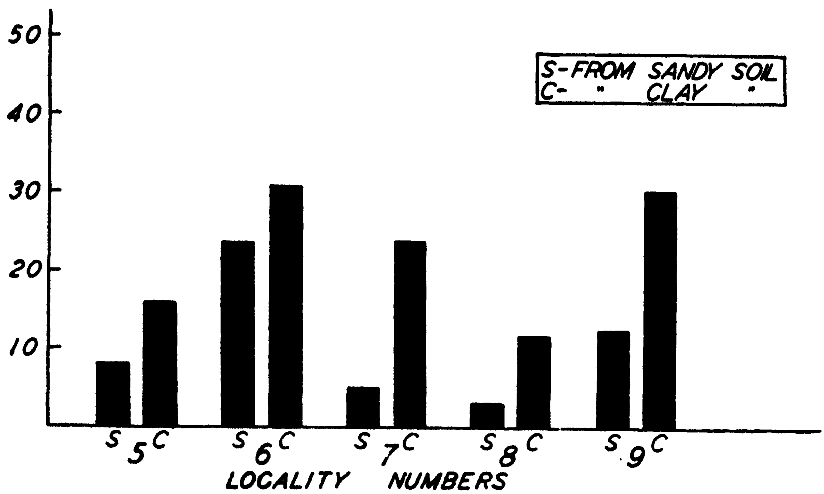

FIG. 1. BITTER-PIT.

Average percentage of bitter-pit in Cox's Orange Pippins for four seasons from five localities and from two soil types

The influence of locality and soil types on the incidence of wastage is well marked (Figs. 1, 2, and 3), bitter-pit and internal breakdown being more pronounced in the samples grown on clay than on sandy soil in the respective localities, but in variable amounts from all localities from season to season.

The highest percentages of general wastage occurred during the 1933 season, while in the 1935 season's trials bitter-pit was very high in the samples of Cox's Orange Pippins from all localities and soil types.

BITTER-PIT.

Fig. 1 shows the average percentages of the occurrence of bitter-pit over a period of four seasons.

Although the figures for bitter-pit show that Cox's Orange Pippin apples grown on clay soils are more susceptible to the disease than

those grown on sandy loams irrespective of locality influences, it would be difficult with our present knowledge not to conclude that the incidence of the disease is influenced from season to season by orchard conditions. It is more serious in large than in small apples, worse on fruit from young than from old trees, especially if the crop is light in association with heavy rainfall late in the growing-season, and susceptibility is increased if the apples are immature when picked. There is no evidence that cold-storage conditions play any part in the incidence or recovery from the disease.

There is no doubt whatever that bitter-pit is responsible for considerable loss each year, and, as stated by Dr. J. Barker, in spite of the numerous investigations which have been carried out in different parts of the world bitter-pit remains a major source of wastage in certain varieties of apples, and critical information as to causal factors is still lacking. Many theories of the origin of bitter-pit have been advanced, but so far none of these can be accepted as proven.

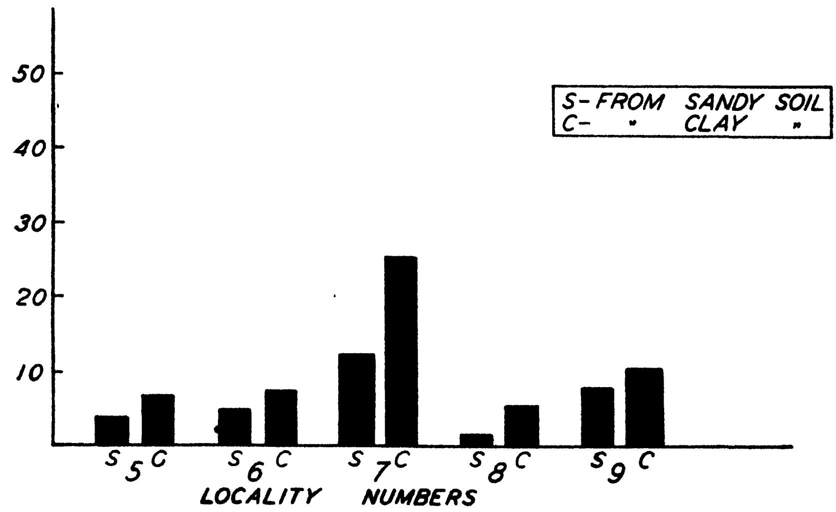

FIG. 2. INTERNAL BREAKDOWN.

Average percentage of internal breakdown in Cox's Orange Pippins for four seasons from five localities and from two soil types.

INTERNAL BREAKDOWN.

As with bitter-pit (although not so extensive), internal breakdown varied with locality, soil types, and seasonable influences. The disease certainly characterizes the end of the storage life of apples. In this experiment the four main types of breakdown which occurred were (1) over-maturity breakdown, (2) bruise breakdown, and (3) breakdown following water-core and bitter-pit. In the former type the apples were soft and mealy, and sometimes the skin of the fruit was cracked; in the second type the flesh surrounding the bruise was soft with a transparent appearance; and in the third type the apples were soft and soggy.

Fig. 2 shows the average percentages for internal breakdown in Cox's Orange Pippin apples from five localities over a period of four years when stored at temperatures of 36° to 38° F.

The data obtained (Fig. 2) indicate a greater liability to internal breakdown in the samples from clay than from sandy loams, and the greatest significance in locality influences appear to occur in locality 7; but a suggestion that the serious development of internal breakdown in the sample was solely due to locality factors may be misleading, as the greater incidence of the disease seemed to be to some extent due to the fruit being in a more advanced stage of maturity than the samples from the other localities, and consequently more liable to breakdown.

FUNGAL ROTTING.

Except in the samples from locality 7, and, to a lesser degree, on the Cox's grown on clay soil from locality 9, fungal rotting, although not actually serious, was sufficiently pronounced to warrant some attention.

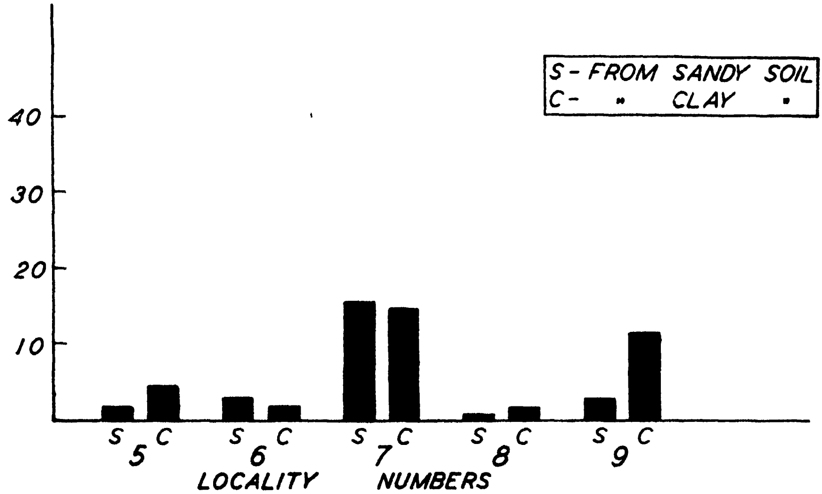

FIG. 3 FUNGAL ROTTING.

Average percentage of fungal rots in Cox's Orange Pippins for four seasons from five localities and from two soil types.

Following on the serious development of internal breakdown in the fruit from locality 7 (Fig. 3), fungal rotting was consistently bad during the period of the experiments, and, as with breakdown, fungal rotting appeared to some extent to be due to the same cause (advanced maturity).

Commercial cold stores were used for the storage of the fruit concerned in the trials. Difficulty was experienced at one shed in obtaining accommodation for holding the samples at air temperatures after removal from cold storage, and on this account the Cox's Orange Pippins from locality 9 had to be subjected to a considerable number of handlings. The evidence appeared to indicate that fungal rotting in these samples was due to post-storage conditions rather than pre-storage or storage factors.

The percentage of the three types of wastage (bitter-pit, internal breakdown, and fungal rotting) shown in Figs. 1, 2, and 3 is merely an average from single plots in two orchards in each locality, and does

not constitute an average for the incidence of the different diseases in Cox's Orange Pippin apples over the whole of any area in any locality.

Maturity at the Time of Picking.

An investigation was carried out to determine the relationship of maturity at the time of picking and the subsequent development of bitter-pit and general wastage (rots and internal breakdown).

As Cox's Orange Pippins are very susceptible to bitter-pit and internal breakdown, comparable samples were gathered at intervals of approximately two weeks at the following stages of development: "Early export maturity," "mid-season maturity," and "late-season maturity." All the conditions as in transport overseas and retail distribution were observed.

Although in all instances (except for bitter-pit) in the early and mid-season samples wastage was slight on removal from storage at temperatures of 37° to 38° F., the "late-season maturity" samples

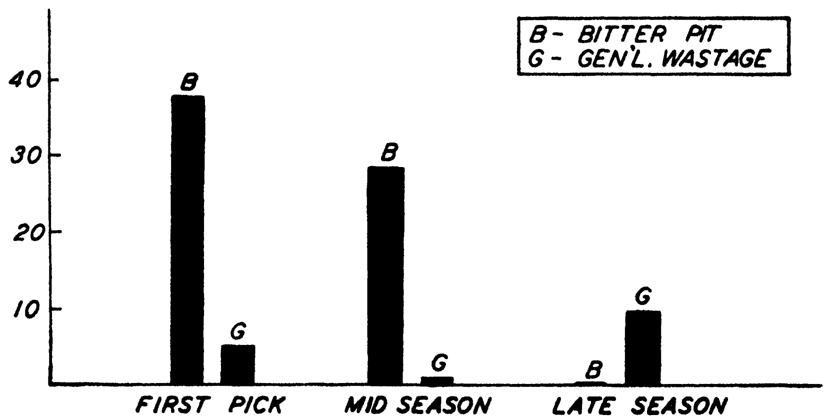

FIG. 4. MATURITY.

Effect of maturity at time of picking Cox's Orange Pippins on the incidence of bitter-pit and general wastage.

were rather more mature than is desirable on the overseas markets, and they showed a greater tendency to develop more wastage than did the less mature fruit (Fig. 4).

The results shown in Fig. 4 reveal a progressive reduction in the amount of bitter-pit and an increase in general wastage the more mature the apples at the time of picking. While the ripe mature samples are not always so free from pit in pit-susceptible seasons, it is appreciably less in its incidence when the apples are allowed to remain on the tree until they are almost fully ripe, but this freedom from pit is offset by an increase in the amount of general wastage.

Transport Temperatures.

In order to collect further evidence of the effect of transport temperatures on internal breakdown in Cox's Orange Pippins, several trials were undertaken with comparable samples—two sizes, 216 and 180, stored at different temperatures, 33° to 35° F., and 36° to 38° F.

During the storage period the temperatures were uniform, and the flesh of the fruit was maintained at 34° and 37° F. respectively. Although the relationship between size and internal breakdown is well known, as might be expected there was very little difference in the amount of wastage in the two sizes—viz., 216 and 180 counts.

The influence of temperatures was, however, significant, and as both samples were free from the disease when they were discharged, the effect of storage or transport temperatures on the development of internal breakdown subsequent to discharge was pronounced (Fig. 5).

Although the ground colour of the skin of the samples held at low temperatures was greener than those stored at the higher temperature, nevertheless the flesh of the latter samples was firmer than that of

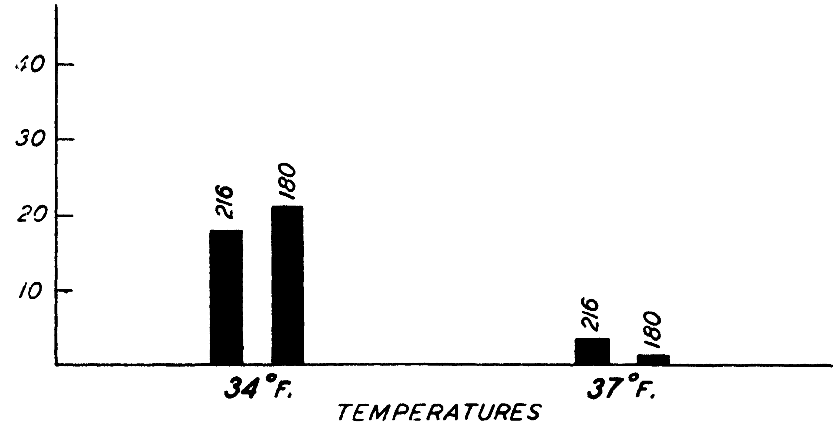

FIG. 5. INTERNAL BREAKDOWN.

Effect of temperatures on the incidence of internal breakdown in Cox's Orange Pippins in relation to sizes

the former, which showed a distinct discoloration. A close observer with a knowledge of low-temperature breakdown could detect the change in the colour of the fruit, and could therefore anticipate early deterioration as against a greater length of life in comparable fruit from storage at higher temperatures.

In assessing the influence of the various factors on wastage in the Cox's Orange Pippins concerned in the foregoing experiments, it should be taken into account that the apples were reduced rapidly and uniformly maintained at temperatures of 36° to 38° F., and that the percentage of wastage given is the total of the various diseases in all stages of development (slight and significant) after exposure to air at approximately 60° F. for eighteen to twenty-one days subsequent to discharge from cold store.

PACKING-PADS.

During the transport of apples through the various channels in transit from packing-shed to the markets, fruit receives numerous handlings of a varying nature, and, in order to reduce the possibility of damage and the consequent development of fungal rotting, different types of packing-pads have been introduced, foremost amongst these being the one-piece

corrugated wraps. To test the relative merits of this wrap in preventing damage, a number of trials were arranged in which the corrugated wrap was subjected to comparison with one-piece plain cardboard wraps, corrugated wraps top and bottom of case only, and no packing-pads.

As it was suggested that the more mature the fruit at the time of gathering the greater the liability to bruising during packing and in transit, samples of comparable size were gathered at two stages of maturity (early and late), packed in the respective wraps, and subjected to similar handling and storage to that obtaining in shipments overseas.

In each experiment four cases of apples were involved, and a standard method of examination and classifying the fruits as slightly or severely bruised was adopted.

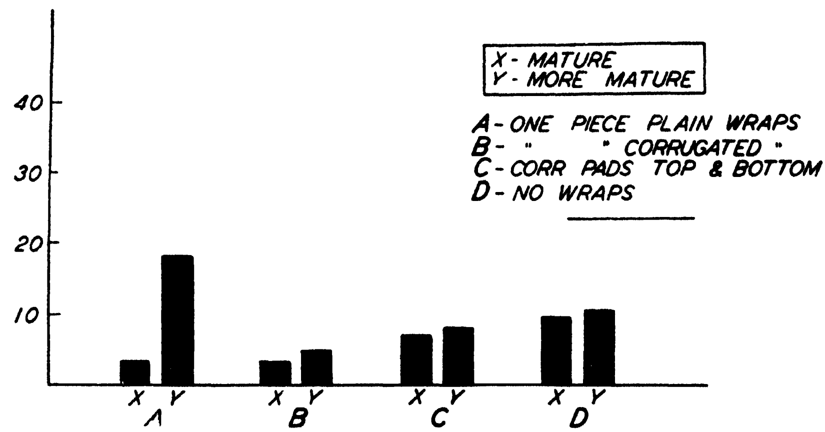

FIG. 6—CONTROL OF BRUISING COX'S ORANGE PIPPINS BY WRAP TREATMENTS, AND THE RELATIONSHIP OF MATURITY AT THE TIME OF PACKING TO BRUISING.

The fruit at the ends, sides, and centre was examined separately, and fruit classed as severely bruised was that to which the trade would take exception, and which would affect its keeping-quality.

The late-picked more mature fruit bruised more severely than the less mature harder fruits. Bruising was more severe in the fruit at the sides of the cases than in the centre. (Fig. 6.)

This result indicates that in the less mature samples more bruising occurred to the fruit in the cases which had no pads or protection on the sides, while in the more mature fruit the amount of significant bruising was greater in the cases with one-piece plain wraps than in the no-wrap treatments. The one-piece corrugated wraps which protect the fruit against all surfaces within the case showed to advantage in diminishing bruising.

Methods of Packing.

Another test in connection with bruising in Cox's Orange Pippin apples was undertaken, in which a comparison was made between two types of packs in one-piece wraps. In one pack the crown was built in the case to give the crown when the pack was finished. In the other the pack was flat above the case, and the lidding-press used to press the apples down at the ends to form the bulge.

In examining these packs the apples were taken out in sections, the two ends and sides and the centre separated. The fruits in the centre of the flat-packed case showed more significant bruising than those at the sides and ends of the case, and where the crown pack was adopted the amount of bruised fruits was markedly less, the difference being 3 to 1 in favour of the crown pack.

SUMMARY OF CONCLUSIONS.

(1) Cox's Orange Pippins from sandy (light) loams are less susceptible to bitter-pit and internal breakdown than comparable apples from clay soils (heavy loams). (Figs. 1 and 2.)

(2) Bitter-pit varies in its incidence with locality influences. (Fig. 1.)

(3) Bitter-pit is greater in its incidence in Cox's Orange Pippins gathered immature, and the disease becomes progressively less the more mature the apples are when they are gathered from the tree. (Fig. 4.)

(4) Susceptibility to internal breakdown and fungal rotting is more pronounced in Cox's Orange Pippins picked more mature late in the season. (Fig. 4.)

(5) Internal breakdown in Cox's Orange Pippin apples is appreciably reduced by storage at a relatively high temperature of 37° F. as against a lower temperature of 34° F. (Fig. 5.)

(6) One-piece corrugated wraps used for lining cases in the packing of apples offers the maximum protection against bruising. (Fig. 6.)

(7) Mature, ripe apples are more liable to bruise than less mature fruit irrespective of wrap treatments.

(8) Apples packed with a crown to the shape of the bulge are less bruised than when finished to a flat surface, and the lidding-press used to press the apples into position to form the bulge at the top and bottom of the case.

EVERSION OF THE VAGINA IN EWES.

A. BAYLY, T H. HANKIN, and P HAUGH, Veterinarians at Wanganui, Masterton, and Gisborne

EVERSION of the vagina in ewes was more prevalent than usual during last lambing period, and the opportunity was taken in the Wairarapa, Rangitikei, and Poverty Bay areas to make further observations on certain aspects of the problem. Before summarizing the information that was obtained it will be as well to review briefly the available reports on the subject.

PREVIOUS RECORDS.

The most complete account of it was given by Gilruth (*N.Z. Dept. Agric. Bull 73*) whose views may be summed up as follows : The eversion occurs suddenly and almost invariably within a week or fortnight before lambing. In most cases the ewe is carrying twin lambs, or, if only one lamb is present, it is an unusually large one. She is in gross condition, or may have an excessive quantity of fat in the adominal cavity, although not externally. Feed is plentiful, and this together with the natural tendency of a heavy ewe in advanced pregnancy, leads to her taking the minimum of exercise. The tendency is to lie down for

long periods, and while doing so the bladder becomes distended with urine to a degree that difficulty is found in urinating when she eventually rises to her feet. Straining is thus induced, " the result of which would be the forcing of the gravid womb back partly over the bladder into the pelvic cavity, and if the pressure were continued—as it would be—it would result in the forcing out of the vaginal membrane." The bladder and the uterus would then pass back into the pelvic cavity, and the pressure would still further prevent the escape of urine. Assuming that this explained the onset of eversion, daily exercise was recommended, the sheep being " roused up " occasionally each day, so as to ensure proper evacuation of the bladder, and it is claimed that where the advice was thoroughly adopted results were excellent. The curative treatment recommended was to cleanse the everted organ and replace it, administering a sedative in the form of laudanum to counteract straining, and a dose of oil or Epsom salts to ensure emptying of the bowels. The orifice could be stitched with tape or locks of wool could be tied across it from either side to assist in preventing a recurrence of the eversion.

On many occasions since Gilruth's time in New Zealand reports on the occurrence of this condition have been obtained from field officers of the Live-stock Division and, in general, they agree as to the circumstances under which it is encountered. There seems to be no doubt that it is prevalent in seasons when climatic conditions in the autumn and early winter have been such as to provide feed in unusual abundance, yet it would seem that there may be more involved than merely gross condition, a high percentage of twins, and a lack of exercise Or possibly one should say that these three factors are not *essential* for the occurrence of eversion- it may occur under other conditions as well.

OUTBREAKS OCCURRING UNDER UNUSUAL FEED CONDITIONS

In an official report on this subject, dated October, 1925, Mr. W. C. Barry, M.R C.V.S (now Director of the Live-stock Division), states : " My own opinion is that the trouble is not always due to an overfat condition of the ewes at lambing, as I have seen it in ewes which could not be considered fat and were grazing on poor country."

Some reports that have reached the Department from its own officers suggest that the heavy, fibrous overgrowth of the pastures present in winters that follow a particularly good autumn growth may have a bearing on the subject, and Mr A. Leslie, F.R.C.V.S., late of Lincoln College, states in a personal communication that in Canterbury a diet containing excess of fibre, such as wheat straw or pea straw, is a common predisposing cause. He has also observed the condition after prolonged turnip feeding with no supplementary feed, and when poorly fed ewes are suddenly transferred to good feed

There may easily be visualized in these cases a condition in which the tissues are flaccid and lacking in tone, which may tend towards the occurrence of eversion just as readily as would an overfat condition, particularly as the diet would involve distention of the rumen, and so increase the pressure within the abdominal cavity.

There are some unusual features associated with the occurrence of this disease in the Marlborough South coast area. From information given by Mr. D. S. A. Weir, Inspector of Stock at Blenheim, it appears

that some years ago eversion was a rare occurrence, but during the five years preceding the autumn of 1935 abnormally dry seasons occurred, and during that time the condition increased till the losses on several farms were considerable. The five dry years changed the type of pasture from rye-grass, cocksfoot, and clover mixtures to mainly danthonia. That is to say, the condition became more prevalent as the pasture deteriorated—which is the reverse of the usual happening. Good rains since 1935 have restored the pastures and improved the feed to a very striking degree, and yet this past lambing, which was an excellent one, saw a comparative absence of eversion cases. Merino-Romney crossbred sheep predominate in the affected area, and, while it is obvious that the circumstances in which the disease occurred differed from the usual, it is felt that certain factors other than the common ones were involved—these may be elucidated when the opportunity for further observations occurs.

EVERSION OCCURRING AFTER LAMBING.

Another feature of this condition, however, which is difficult to explain is the fact that cases undoubtedly occur in ewes that have been lambed for a considerable period. In the Marlborough South coast area there have been many instances wherein about half the cases occurred a few days before lambing and the others at various times from after lambing up to shearing time (roughly from September to January). An instance has been reported by Mr. C. V. Dayus, M.R.C.V.S., of Dunedin, in which the condition occurred in February among some ewes that had lambed normally the previous October. They were sheep of a large roomy type, and were on irrigated pasture in which clovers predominated, so that rich and succulent feed was available to them with no effort

There is no evidence whatever that the condition is in any way infectious or contagious.

THE PRESENT INQUIRY.

When inquiries were instituted in our respective districts last year it was thought desirable, as a commencement, to concentrate attention on certain points and to collect information about them from a series of farmers in each district. This was duly done, and a mass of information was obtained from a total of nineteen farms, which it is possible only to summarize very briefly here. The points on which inquiry was made and the summarized information obtained on each may be set out seriatim :—

What was the incidence of affected ewes in the flock ?—On the nineteen farms the incidence was—On five farms 1 per cent , on three 2 per cent., on five 3 per cent., on three 4 per cent., on one 5 per cent., on one 7 per cent., and on one 8 per cent.

What were the feed conditions during autumn and winter, and of the flock prior to lambing, and have climatic factors any influence ?—In every case feed had been exceptionally good, and the ewes approached lambing in high condition. Several farmers commented that there had been an almost spring like growth practically throughout the winter, and that the ewes were putting on condition all the time.

As to climatic factors influencing the actual occurrence of eversion, it is believed by some farmers that the trouble occurs mostly in cold weather, and that close crutching makes the ewes more susceptible to it. One owner stated that when his stud Southdowns were machine crutched a number were affected with eversion each year, but for the past few seasons he has merely trimmed them lightly with hand shears and the trouble has practically ceased. Another farmer stated that during one exceptionally frosty season his own ewes, which were machine crutched, were severely affected whereas similar but uncrutched ewes on adjoining paddocks were unaffected. Further inquiries on this point will be instituted.

The age and type of affected ewes.—The condition was more frequently met with in mature and aged sheep than in younger ones, but in not a few cases losses occurred among maiden ewes and 6-tooths as well. The flocks investigated were Romneys, Southdowns, Romney-Lincolns, and Romney-Southdowns, and, given similar conditions, there seemed nothing to chose between them. Some owners considered that the "roomier," more "stockily built" type of ewe was more prone to evert her vagina. In this connection it is of interest to record that the Marlborough South coast area farmers stated that the disease was not found in the pure Merino, but occurred in the half-breds and three-quarter breds which are "roomier" than the pure Merino. One or two owners in that locality stated that the incidence increased after they had used Romney rams, and had thus bred a broader type of ewe, and decreased again when they went back towards the pure Merino type of body.

What was the proportion of affected ewes carrying twin lambs?—In one case the affected ewes were mostly carrying single lambs and in three others about 50 per cent. were twin pregnancies. In the other fifteen cases twin pregnancies accounted for from 75 per cent. to 95 per cent. of the incidence.

When the size of the lamb was inquired into in cases where ewes with singles were affected, it was considered in six cases that they were generally unusually large, but in most cases particular notice had not been taken on this point. It was observed by several farmers that, in general, all the lambs on their farms this season were large and strong at birth (which confirms the good feed that had been available to the ewes during pregnancy).

What was the influence (if any) of the use of salt or other mineral licks on the incidence of the disease?—So far as the information went the use of rock salt, various salt licks, and of certain proprietary mineral mixtures appeared to have no effect on the incidence of eversion of the vagina. As one example one might refer to the fact that the heaviest incidence noted—viz., 8 per cent.—occurred on a farm where rock salt is permanently available to sheep in all paddocks, and the next heaviest—viz., 7 per cent.—on a farm where no licks nor top-dressing had been used at all.

What was the incidence of antepartum paralysis (sleeping sickness) compared with that of eversion of the vagina?—The reason for inquiries on this point was that antepartum paralysis is now considered to occur principally when ewes are falling off in condition as lambing approaches, or when high-conditioned ewes receive a check or set back in condition

at this time, whereas eversion is usually associated with ample feed. Hence in a season when eversion is common antepartum paralysis should (other things being equal) be relatively uncommon.

On sixteen of the nineteen farms where eversion of the vagina was prevalent the incidence of antepartum paralysis was nil or negligible. Special mention must be made of the remaining three farms.

The natural tendency for the farmer who sees eversion cases among his sheep and associates it with an overfat condition is to starve the ewes—but that is a most dangerous procedure, since fat ewes in advanced pregnancy that are given a check in that way are very likely to develop antepartum paralysis. The following are instances of this on the three farms in question : (A) Attempted to force a mob of ewes that were near lambing to eat silage. They were unaccustomed to this feed and refused it for some days. Thirty of them died from antepartum paralysis. (B) Became alarmed when eversion cases appeared. Thinking to reduce their high condition he crammed all his ewes on to a 6-acre paddock for two days, then put them on to other paddocks at the rate of four to the acre and, in addition, drove them several miles a day along the road. Within a few days twelve died of antepartum paralysis. He then spread the ewes over their original paddocks and left them alone. Cases of antepartum paralysis ceased to occur but eversion continued as before. (C) Put seven hundred ewes in an 80-acre paddock about a month before lambing, and kept them there for a fortnight. Nine died of antepartum paralysis. The paddock was then spelled for only a week when he put four hundred ewes in it and drafted them out as they lambed. Eleven of these died of antepartum paralysis. These cases should prove a sufficient warning to farmers of the danger of flying from one extreme to the other.

What preventive measures were tried and with what result ?—On eleven of the farms no attempt was made to prevent the condition. Others took various measures, which were scarcely likely to be very effective, as follows : (A) Went the rounds twice daily and "roused up" any ewes that were lying down. (B) Put the ewes in small paddocks and changed at short intervals. (C) Exercised ewes spasmodically and moved them from a higher to a lower paddock according to the weather (D) Put ewes in a fresh paddock when lambing about to begin- to induce restlessness. (E) Crammed ewes on to a small paddock to lamb (dangerous as well as useless).

One farmer took considerable trouble in an effort to prevent these losses, as he was a heavy loser on a previous occasion and anticipated trouble this year owing to plentiful feed. He was unsuccessful, and it will be as well to give particulars in his case and to consider why he may have failed. He had 2,000-odd ewes, due to lamb on and after 20th August. From 21st June to 1st August he changed paddocks at 3-day to 5-day intervals. On 1st August some 500 early lambers were placed on a good paddock, and moved round it *every second day*. Another 400 ewes were added to the paddock on 10th August, and on 14th August the first case of eversion occurred. By 23rd August there had been thirteen ewes affected. Thus under these conditions there were thirteen cases in ten days among 900 ewes.

He then moved 500 of them to a 20-acre paddock of inferior grasses (sweet vernal and Yorkshire fog, &c.), moved them about

in it twice daily, and drafted out those which lambed. Under these conditions there were seven cases in five days among 500 ewes (approximately the same rate as before). Moreover, the mob was going back in condition, becoming sluggish, and antepartum paralysis began to occur. He therefore moved the remainder of the 500 to a better paddock. There was one case the following day, then none for three days, after which they commenced again. He then put them back on the poor 20-acre paddock for three days and had no more cases.

His experience of the disease can be divided into two periods—from 1st to 23rd August, during the latter portion of which he had thirteen cases, and from 23rd August to early September, during which about as many more were affected. In the former he had crowded the sheep on a good paddock. They were already in heavy condition, and near lambing, and under these conditions would take even less exercise than before. His moving them about the paddock every other day would be unlikely to confer any benefit whatever at that stage. In the later period many of the ewes must have been very near lambing, and they were crammed up closer than ever on a much poorer paddock. The result would be that many of them would take practically no voluntary exercise. The feed not being sufficiently tempting, and there being so many of them to the acre, the heavier ewes would lie down rather than bother in the unequal struggle, and apart from the stirring up they received twice daily, would probably spend most of their time in the lying position. With these points in mind it seems clear that he could hardly expect better results than were obtained.

Compare this case with the final one of the series—the only one of the nineteen men who took successful preventive measures. It is his practice, when the first case of eversion occurs, to drive the ewes about a mile night and morning, giving them an hour on a root crop before travelling back to the paddock, and in the lots which he can handle in this way the condition is well controlled.

What curative measures were tried by the farmer and with what result?—The treatment applied is to cleanse the part and return it into position. Some apply various agents such as weak vinegar as an astringent, or olive-oil as a lubricant, but in most cases the everted portion is merely cleansed, disinfected, and pushed back, and the wool tied across from side to side, or stitches, safety-pins, &c., put across the orifice. A number of the farmers placed affected ewes in the wool-shed for a few days, letting them out for an hour or two of grazing during the day. The results of this rather perfunctory treatment varied from about 15 per cent. to 90 per cent. successful, but it is difficult to give any sound estimate of its results since in many cases where seemingly very good results were obtained it was found on inquiry that only the most favourable cases were treated at all, the rest being killed. Then, again, the result depends on how closely the flock is shepherded, since the success of any line of treatment in this condition will obviously depend on how soon the matter is dealt with after eversion has occurred.

What were the results of post-mortem *examinations of affected ewes?*—Only on a few occasions were such examinations possible, but these confirmed the fact that the only abnormality concerns the eversion of the vagina. Considerable congestion is seen and there are often blood-clots about the neck of the bladder, but such lesions naturally result from the disturbance of the circulation consequent upon the eversion. Constipation was not a feature of the cases examined in this way.

In this connection it should be said that while it is a common belief among farmers that there are two forms of this disease, they are, in fact, merely different degrees of the same condition. The form it takes depends to a great extent on the time at which it occurs. If it takes place about a fortnight before lambing the eversion is usually long and sausage-shaped. There is not complete obstruction to the passing of urine, at any rate at first, and if taken early this type can be treated with a good prospect of success. The eversion which occurs closer to lambing than this is rounder and more swollen in shape. There is complete blockage of the urinary passage, the bladder quickly becomes acutely distended, and this increases the size of the everted portion besides making it impossible to return unless the urine is first drawn off. Cases of this sort are much more difficult to treat successfully than the former, and from *post-mortem* examinations on ewes that have died of this form of eversion it is seen that the seriousness of the cases is due to the stoppage of urine having caused serious back pressure on the kidneys. Such cases often die quite quickly as a result of this, being poisoned by their own excretion, which they are unable to void.

What information can be obtained regarding cases of eversion which occur at times other than just before or just after lambing?—Reference to these was made at the commencement of this report. They are found especially at shearing-time. Inquiry was naturally directed first at discovering whether such ewes were ones which had been affected at, or prior to, lambing, and in cases where definite information could be obtained it showed that this was so in the majority of cases.

On three farms, for instance, there was a total of twenty cases found at shearing-time, and all were marked ewes that had been affected at lambing. In other cases it was thought that the same applied, but as the ewes affected at lambing had not been marked there was no means of discovering the truth. One farmer had a few cases among recovered ewes when he yarded them about a fortnight after lambing. Another, who had several cases of eversion before lambing, and managed to save only a few of them, claimed that the number of cases found between lambing and shearing exceeded the number that he saved at lambing-time. Unfortunately, he had kept no records, nor were the ewes affected at lambing marked in any way, so that there must be some doubt as to the extent to which his impressions were correst. However, one report from Poverty Bay stated that odd cases occur each year on that property in hoggets. Reference was made earlier to the occurrence of cases long after lambing in the Marlborough South coast district, and as some of the farmers supplying the information were in the habit of slaughtering

all ewes that became affected prior to lambing, without attempting to save any, the after-lambing cases must necessarily have been fresh occurrences. Mr. Dayus's cases had also lambed normally.

It is said that in the cases occurring after lambing, as with those at the more usual time, there are two forms of eversion—viz., (1) A cone-shaped protrusion about 6 in. in length and about 2 in. in diameter. This protusion includes in it the prolapsed uterus, the mouth of which can be found just inside the hinder end of the cone. (2) A smaller, rounder protusion which is composed of the everted hinder portion of the vagina only. In cases of either type that are found at shearing there is generally evidence that the condition has existed for some considerable time, as the everted portion (which is seldom actually inflamed unless it has been damaged by the ewes' movements during yarding) is tending to become fibrous and toughened. Such ewes have usually lost condition and are killed for the dogs, as treatment in old-standing cases of this type is not hopeful. When the after-lambing eversion is found at the time of its occurrence the usual treatment by cleansing, returning, suturing, &c., is generally successful.

The prevailing opinion, which the observations related above tend to support, is that at least a very large proportion of the cases found at shearing are among ewes that were affected prior to lambing. These are readily understandable, as once the part has been everted the stretching and relaxation of the attachments that is involved will naturally make a further similar occurrence so much the easier.

There remain those cases in ewes, and sometimes in hoggets, that cannot be associated with any previous occurrence, and meantime we have not sufficient accurate observations on which to base a sound opinion as to their cause.

Discussion and Conclusions.

The information here summarized resulted from a preliminary survey, and in subsequent seasons it is hoped to continue the work. Meantime, however, there are certain points arising out of facts related above which it should be of value to emphasize, as follows :—

(1) The condition is an important source of loss in certain seasons. The major losses are associated with climatic conditions which produce abundant feed and hence can be, and should be, anticipated.

(2) Preventive measures are not practised as they should be, save in a very few cases. Admittedly there are circumstances in which they are scarcely practicable, but for most farmers some organization and foresight should make it possible to provide the necessary daily exercise and to so regulate the feed as to maintain the sheep in vigorous condition. It is necessary to attend to this well before the time that cases are likely to occur. If nothing is done till trouble begins it is much more difficult to check the loss. The actual eversion is only a symptom of the condition the sheep are in, and that condition must be prevented, not cured. If cases occur, do not take drastic measures that will set the ewes back suddenly, or the consequent loss from antepartum paralysis may be greater than would have occurred from eversion.

(3) As regards treatment, a point to be strongly emphasized is that when eversion occurs in a flock close shepherding must be

adopted. Shepherding once a day is not enough, and is responsible for much of the actual loss from this disease. Cases often occur just after the daily visit and are consequently not found till next day, when the everted organ has become fouled and damaged and the bladder and kidneys seriously injured through inability to void the urine. For successful treatment it is essential to deal with each case as soon as possible after it has occurred, and the only way to do that is to go round the ewes twice or, if possible, three times a day.

As soon as opportunity offers it is intended to carry out some experiments as regards treatment, but in the meantime brief reference may be made to certain essentials. The first thing to do when the affected ewe is caught is to empty the bladder. There is usually no difficulty about this if she is gently placed on her back, as this removes the pressure of the everted organ from the urinary outlet. Occasionally slight manipulation of the everted portion may be necessary to start the flow. Then any dirt should be removed and the part gently cleansed. For this purpose carbolized oil is probably as good as anything, as a bottle of it can readily be carried on the rounds, whereas disinfectants which require water for their use are impracticable for such an occasion. Moreover, the oil softens and soothes the inflamed part and assists in its return. To replace the everted part to its normal position the hind quarters of the animal (still lying on its back) should be raised up, and a little gentle pressure and manipulation will soon succeed. Use the flat of the fingers, as the tips may tear or rupture the delicate membrane that is exposed. Now tie locks of wool across the orifice to prevent a recurrence meanwhile, and take her back to some handy place near the homestead or shed where further treatment can be given if needed and she can be kept under close observation till safely lambed. If sheep so treated are placed in the shed, or a small paddock nearby, they must not be left without attention. They must be properly fed and exercised. One excellent thing to give them each day is about half a pint of linseed-jelly. This is made by half filling a kerosene-tin with linseed and adding enough boiling water to nearly fill the tin. Stir well, cover with a sack, and leave till cold. The jelly so formed is relished by both cattle and sheep and is both nutritious and laxative.

(4) Lastly, it has been very noticeable during this investigation that most farmers fail to mark affected but recovered ewes so that they can later be picked out and culled. That should not be. It is necessary to mark and cull such ewes, because if they do not have a recurrence of the eversion between lambing and shearing they generally do so at the next lambing if the season favours the condition at all. Moreover, there may be some grounds for the belief that it is mainly the ewe that is of a certain stocky type, with a wide pelvis, that is liable to the condition, and if future observations bear this out it will be desirable not only to cull the ewe herself, but her lambs also, since such a type of body conformation is liable to be inherited.

In conclusion, it should be reiterated that the above is an account of field observations of a more or less preliminary nature and that it is hoped, as opportunity offers, to carry out further work on this disease, particularly regarding methods of prevention and treatment. It is also recognized that much more detailed information is needed about the feed conditions and other factors which predispose ewes to it.

LUCERNE.

POLLINATION AND SEED-PRODUCTION.*

J. W. HADFIELD and R. A. CALDER, Agronomy Section, Plant Research Station, Palmerston North.

THE structure of the lucerne flower is such that the pistil and stamens are enclosed in a tense position within the keel. When this tension is released, as may be effected by pressing the point of a pencil into the corolla-tube, the pistil and stamens spring forward causing the pollen to be distributed, and the stigma to strike with some force against the standard, or against any object that is between the stigma and the standard. This process is referred to as "tripping" the flower and allows the pollen to become available for, and the stigma receptive to, pollination. If the pollen of a flower falls on the stigma of the same flower, or on another flower of the same plant, it is said to be self-pollinated. If the pollen from one flower is transferred to the stigma of a flower on another plant it is said to be cross-pollinated. When fertilization is effected by either of these means it is referred to as self-fertilization and cross-fertilization respectively.

TRIPPING IS AN ESSENTIAL PRELIMINARY TO SEED-SETTING.

The majority of investigators agree that a flower will not set seed until it has been tripped. In an investigation at this Station it was shown that for every 100 florets tripped sixty-eight seed-pods were formed, but for every 100 florets not tripped only one or two seed-pods were formed; and, as it is not always possible to be certain whether or not tripping has taken place, it is more than probable that this small percentage was in reality an error of judgment. We may conclude therefore that tripping is essential for seed-production, and that seed-yields will be influenced by the amount of tripping that takes place. In these trials it was possible to double the seed-yield by means of artificial tripping as an aid to natural tripping. Artificial tripping in this case was brought about by rolling the infloresences between the fingers (Fig. 1).

HOW NATURAL TRIPPING IS EFFECTED.

It is instructive to observe the ways in which tripping is effected. A lighted cigarette tip placed near a flower will cause it to trip. Heat, or perhaps what would be more correctly described as a sudden change in temperature, is therefore an agent bringing about tripping. On a hot dry day the flowers trip very readily, and, if under such conditions they are agitated, or lashed about by the wind, many of them become tripped. The wind is then a second agency. Insects are, however, perhaps the most interesting of the agents, since the shape and structure of the flower appear adapted to the visits of such insects as bees. From this structure it would appear that a bee, when visiting the flower, should push down the corolla-tube in search of nectar and in doing so

* A full account of these investigations has been published in the New Zealand Journal of Science and Technology, Vol. XVII, No. 4. "Lucerne: Investigations relati e to Pollination and Seed-production in New Zealand." J. W. Hadfield and R. A. Calder, Plant Research Station, Palmerston North.

FIG. 1. TRIPPING AS AN AID TO SEED-PRODUCTION.

Top left, covered and hand-tripped; top right, covered and not tripped; bottom left, exposed to open pollination and hand-tripped, bottom right, exposed to open pollination and not tripped.

should trip the flower. By tripping the flower in this way the pollen would be dusted on to the underpart of the bee and simultaneously the pistil would strike the bee on the same part, thus receiving on its stigma pollen which the bee had carried there from another flower. In this manner would be effected not only tripping but also cross-pollination. Observations in the field, however, do not support this entirely.

THE HONEY BEE AND BUMBLE BEE AS FLOWER-TRIPPING AGENTS.

Honey bees visit the lucerne flowers in large numbers, but very rarely do they effect tripping, and then incidentally while climbing over the flowers in search of nectar. A honey bee normally obtains its nectar by inserting its tongue from the side of the flower. If the flower happens to trip while this is taking place the bee has to withdraw its tongue forcibly, and its consternation is so evident that one must conclude that it is quite unaccustomed to the tripping of flowers.

By maintaining hives within large cages it was proved that the honey bees, black, Italian, hybrid, and Caucasian were all equal in their effects upon seed-production (Fig. 2).

Of the bumble bees, one species (*Bombus terrestris*) pushes boldly into flower after flower with great rapidity, tripping each in what might be termed an orthodox manner. Another bumble bee (*Bombus subterraneans*) is apparently of no use in this respect. It takes its nectar, as does the honey bee, from the side of the flower, and no further reference is made herein to this species.

The bumble bee (*B. terrestris*) has proved to be a very efficient agent in stimulating the setting of seed. For example, by maintaining a bumble bee in a cage enclosing two plants the seed-setting as compared with normal open pollination was raised from sixty-five seeds per 100 florets to one hundred and seventy-six seeds per 100 florets, which is an increase of nearly 300 per cent. (Fig. 3).

In the large bee-cages it was proved that a dozen bumble bees were able to cause more seed to set than about 4,000 honey bees. Unfortunately bumble bees, in this district at least, are insufficient in numbers materially to affect seed-production.

Despite the somewhat unfavourable position in which honey bees are placed when compared with the bumble bee, they are by no means useless. They do trip flowers on occasions and they may be present in such large numbers that collectively they trip as many flowers as do the relatively few bumble bees. For example, within the cages where the honey bees were concentrated in large numbers the seed set there was more than twice the amount that was set outside the cages, so that it is evident that, however inefficient honey bees may be when compared with bumble bees, they can by their very numbers result in a quite considerable increase in seed-production.

Furthermore, they become dusted with pollen as they climb around the flowers, and this pollen they scatter on other flowers, the advantage of which will be discussed later.

ARTIFICIAL TRIPPING OF FLOWERS.

Since tripping is essential to seed-production, it seems reasonable to suppose that some implement could be devised which, when drawn over a field of lucerne while in full flower, would cause an increase in

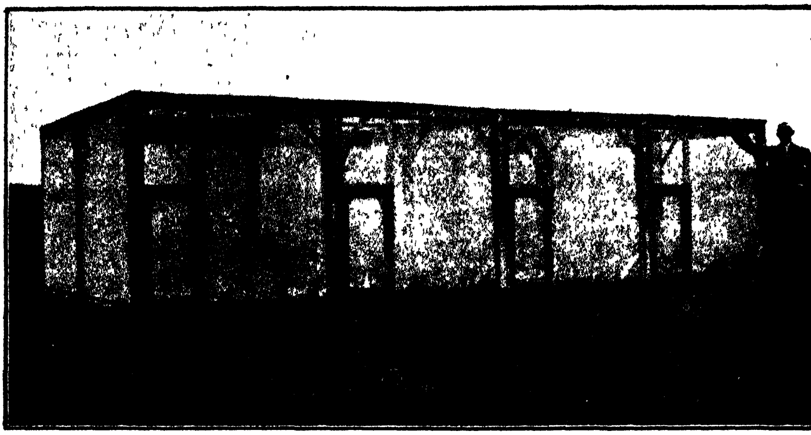

FIG. 2. LUCERNE POLLINATING TRIAL.

Bees of various kinds were maintained in these cages to determine their efficacy as pollinating-agents.

FIG. 3. *Bombus terrestris* AS A POLLINATING-AGENT.

The central branches were caged and one bumble bee maintained within the cage. The outside branches were exposed to open pollination. Note the increased seed-production resulting from the activities of the bumble bee.

tripping, and thus an increase in seed-production. Attempts have been made to devise such an implement without so far attaining much success. At this Station a blast of hot air has been most effective, but an implement devised to bring this principle into effect over a large area would be both cumbersome and expensive. It has already been stated that artificial tripping as an aid to natural tripping has greatly increased the yield of seed at this Station. There is, however, in this connection another matter for consideration—namely, that the artificial tripping of flowers would necessarily result in a high proportion of self-pollination, and it is desirable for this and other reasons to consider the relative effect of self and cross fertilization.

SELF-POLLINATION VERSUS CROSS-POLLINATION.

Trials have indicated that under normal conditions at this Station far more self-fertilization takes place than cross-fertilization. Therefore the lucerne flower, although apparently constructed to effect cross-pollination, is to a very large extent self-pollinated.

The first observation to be made on the effect of self-pollination is its marked reduction in seed-production when compared with the effect of cross-pollination. Thus, in one typical trial, self-pollination resulted in 53 per cent. of the pods setting seed, the average number of seeds per pod being two. The same plants under cross-pollination resulted in 92·5 per cent. of the pods setting seed, and the pods contained an average of 6·5 seeds. Therefore, under self-pollination there were produced 106 seeds for every 100 florets, and under cross-pollination 601·2 seeds, which is a very substantial increase.

The second observation is that self-fertilization reduces vigour, and that plants raised from seed that has been produced by self-fertilization are far less vigorous, are more susceptible to disease, and yield far less herbage than plants raised from seed which is the result of cross-fertilization.

Therefore the greatest increase in both seed-production and herbage-production is consequent upon cross-fertilization. It is possible to increase seed-production by increased tripping, but such tripping should, if possible, be accompanied by cross-fertilization.

It is reasonable to suppose that in some seasons and in some districts much more cross-pollination will take place than in others, and that an increase in seed-production will follow an increase in cross-pollination. We may infer, therefore, that in these districts and in those seasons in which the greatest seed-yields are obtained are those in which the seed produced is likely to be of the highest value. Conversely, a low yield of seed may reflect, amongst other things, a high degree of self-fertilization, and such seed might be expected to produce a poor crop. These are merely inferences, since the point has not yet been proved. All the evidence points, however, to the importance of cross-pollination, and some of the agencies responsible will now be discussed.

AGENCIES BRINGING ABOUT CROSS-POLLINATION.

From what has been said the bumble bee must be regarded as a very effective agent, and investigations into the possibility of increasing their numbers and introducing new species is worthy of consideration.

An inspection of untripped flowers has revealed lucerne pollen adhering to the flower-standards, so that, if tripping were to take place, some

cross-pollination would be effected. This pollen finds its way on to the standards no doubt through several agencies, one of which is wind. Thus under rather unsatisfactory conditions for wind distribution of pollen, greased slides were suspended above a lucerne crop for twenty-four hours. A microscopic inspection revealed an appreciable amount of pollen adhering to the slides—this pollen must have been blown there by the wind. It has already been pointed out that honey bees also play a part in distributing pollen, and finally the flower itself, when tripped in warm weather, does so with an almost explosive action scattering pollen around.

CONCLUSION.

While it has been possible to prove that there is ample scope for improvement in the yields of lucerne-seed, it must be acknowledged that no new and practical way has been suggested whereby seed-production might be stimulated, more particularly as a result of cross-pollination. Nevertheless, only by the study and with the knowledge of the circumstances surrounding pollination and seed-production could such suggestions be forthcoming, and the work will not have been in vain if it induces others to take an interest in this problem and make observations in the field.

In the meantime the only recommendation that can be made is that growers should concentrate as many hives of bees as possible in lucerne crops that are being saved for seed.

SUSPECTED ZINC POISONING IN PIGS.

A POSSIBLE DANGER IN THE USE OF GALVANIZED-IRON PIPING FOR CONVEYING SKIM-MILK TO PIGGERIES.

R. E. R. GRIMMETT and I. G. McINTOSH, Chemical Laboratory, Department of Agriculture, Wellington.

DURING the past twelve months several cases of heavy mortality amongst young pigs and unthriftiness in older pigs, not traceable to infectious disease, have been associated with the installation of new piggeries to which skim-milk has been pumped through galvanized-iron pipes some considerable distance.

In the first case subject to detailed investigation two piggeries had been run in connection with two dairies on the same farm for two years without any trouble among the pigs. These piggeries were situated alongside their respective dairies, with only very short lengths of piping to convey the milk. Early in 1935 a new pipe-line 16 chains long was connected with one dairy and the pigs shifted out on to clean ground at this distance. Numerous deaths occurred among the young pigs shortly afterwards. The pigs comprised about twenty-four suckers on mothers and thirty stores.

During the ensuing winter molasses and water (pumped through the same pipes) was fed to the pigs, very little milk being available, and the remaining pigs did quite well. Seven sows farrowed in the spring.

When milk again became plentiful in the spring and was pumped in quantity through the pipes about forty to fifty pigs died. The symptoms noted were—pigs went off their feed, got up on toes with stilted gait, showed swelling of joints, and lameness, became unthrifty, half-grown pigs failed to grow, young pigs died, while sows (presumably suckling young) were mostly unaffected. During this period the pigs at the other shed (short pipe-line) were unaffected. No evidence of serious infectious disease could be found.

Analysis of organs of a young pig that had died and the milk that it had been fed with gave the following results:—

	Percentage of Zinc on Samples as received.
Stomach contents (mostly material other than milk)	0·0032
Liver	0·044
Spleen	Trace.
Skim-milk that had passed through pipe—	
Liquid portion	0·016
Curd	0·082

The curd contained much liquid, and assuming that about equal proportions of the material represented by each sample was present in the trough, the average of the zinc in the skim-milk would thus be 0·049 per cent., or as zinc oxide, 0·061 per cent., or practically 10 per cent. of the ash of the milk.

The zinc in the liver was more than ten times the amount normally present. Bones from this pig were found to contain 0·074 per cent. of zinc on the ash.

Arsenic, lead, and other poisonous metals which, as possible impurities in the zinc, might have been responsible for the mortality were sought for in all samples with negative results.

Subsequent samples from other pigs confirmed these findings, and on obtaining sections of the pipe-line before and after use it was found that the galvanizing (zinc lining) of the inner surface had been almost entirely removed, being replaced by a thick layer of curdy or cheesy material. Assuming that the zinc removed from the 16 chains of pipe had all gone into the milk and been fed to the pigs, it was estimated that they must have consumed approximately 50 lb. of pure zinc.

After an interval of two months, during which the severity of the trouble diminished considerably, further samples were received, being specimens from a pig that was still ailing. Their content of zinc was as follows :—

	Percentage of Zinc on Samples as received.
Stomach contents	0·004
Heart	Trace.
Liver	0·022
Spleen	Trace.
Intestine and contents	0·004
Lungs	0·0017
Fluid from knee joint	Distinct trace.
Kidney	0·005

Skim-milk passed through the pipe-line now contained 0·0024 per cent. zinc, while milk straight from the separator contained less than 0·0004 per cent. Apparently practically all the zinc had now been removed from the pipe-line, and the pigs were slowly eliminating the zinc from the soft tissues and organs. Zinc held in the bones would, however, presumably be eliminated much more slowly.

Some months later a second case was reported independently from another part of the Waikato. The whole history of the case was practically identical with the first one, and was verified by a personal visit. Undue pallor of tissues and organs was noted in the post-mortem examination by the Veterinarian Samples again gave similar results :—

	Percentage of Zinc on Samples as received.
Skim-milk from vat—	
Fluid portion	0·015
Curdy portion	0·083
Stomach contents (three-months-old pig) ..	0·100
Kidney	0·005
Liver	0·012

Other suspected cases are under investigation. It is fairly evident that some of the milk adheres to the metal surface of the pipe and is not removed by flushing with water. This film then sours and the lactic acid attacks the zinc. Further accretions of milk would rapidly take place on this already sour and decomposing film, promoting continued attack. The deposit would break away from time to time, carrying with it the dissolved zinc. It is notable that during the period when only molasses and water was fed through the pipes the mortality ceased.

The literature on the toxicity of zinc is very contradictory. Standard text-books quote cases of poisoning, and report recoveries of zinc from the organs of animals that have died following the ingestion of zinc salts. In most cases, however, the poisoning has been of an acute type due to the caustic action of zinc chloride on the mucous membranes of the alimentary tract. Experiments on the injection of non-caustic zinc compounds show, however, that zinc administered in this way causes symptoms of poisoning terminating in death. Some recent experimenters, on the contrary, claim that zinc fed in small quantities over long periods to dogs and rats is non-toxic. Drinker (*Amer. Jour. Physiol.* 80 (1): 1927, 31–64) fed cats and dogs with daily doses of zinc oxide of 0·175 gramme to 1 gramme for periods of three to fifty-three weeks. It is claimed that no significant clinical symptom or laboratory evidence of damage was observed. All three cats on the highest dosage of zinc (1 gm. per day) exhibited however, at autopsy, gross hardening and nodular development of the pancreas, which on histological examination proved to be generally overgrown with fibrous tissue, partially or wholly eliminating the islets. The liver of one of these cats thus affected contained about 0·037 per cent. of zinc. It is also evident that not more than a minute fraction of the zinc oxide fed was absorbed. Zinc oxide probably is less readily absorbed than other more soluble compounds of zinc. Again, the pig seems to be an animal peculiarly susceptible to various poisons.

Heller and Burke (*Journal of Biological Chemistry*, 1927, *74*, 85–93) fed rats with amounts of zinc salts of 0·25 per cent. and 0·5 per cent. of zinc in the diet. It is stated that no toxic effect was observed over several generations. However, the figures show that in the group receiving 0·5 per cent. of zinc as chloride there was a mortality of approximately 40 per cent. of the young, while in the group on 0·25 per cent. zinc the mortality in the young did not rise above 20 per cent. Moreover, the analytical results on the carcasses show clearly that either there was practically no absorption of zinc from the alimentary canal, or, if any were absorbed, it was eliminated immediately again by the same path. No significant increase of zinc in the organs was obtained.

Thus these results differ markedly from the cases in pigs now reported, in which clear evidence of absorption and storage is available. The total amounts of zinc consumed by the pigs have also probably been greatly in excess of the relative amounts fed in the small-animal experiments.

In view of the great extension in the method of feeding pigs with skim-milk pumped through galvanized-iron pipe-lines, and the apparent increase in obscure mortality and unthriftiness in pigs, further investigation of this matter is desirable. In the meantime caution should be exercised and the installation of extremely long pipe-lines avoided.

The co-operation of Mr. D. Marshall, Veterinarian, Hamilton, in obtaining and forwarding post-mortem findings, samples, and data is gratefully acknowledged ; also that of Mr. C. R. Taylor, formerly of this Laboratory, who brought the first case under notice and obtained much

information relating thereto. The work has been carried out under the direction of the Chief Chemist, Mr. B. C. Aston, to whom our thanks are due for interest shown and advice given.

SPROUTED GRAIN FOR SEED-WHEAT PURPOSES.

I. D. BLAIR, Canterbury Agricultural College, Lincoln.

THE 1936 harvest will long be remembered for its abnormal rainfall and the great difficulty encountered in saving the late crops. The fact that 9·5 in. of rain fell between 3rd February and 14th March in Canterbury, in comparison with 1·8 in. the average for the preceding forty years, indicates that flooding seriously hampered harvest operations. Apart from the delay in seasonal work, the majority of growers had the misfortune of seeing their crops severely damaged, with the grain sprouting in the stook, and in many cases in the standing crop. Many farmers have recently been concerned about the value of sprouted lines of wheat for seed purposes. One occasionally hears of farmers who state that they have grown good crops from sprouted seed, but it must be remembered that there are various degrees of sprouted wheat, and while one man may have been successful, others may have quite different results. The question of sprouted wheat for seed purposes has been investigated, and in the May issue of the *Journal* a preliminary report on the germination of sprouted grain was issued for the benefit of those farmers who were sowing at the time. The complete results of the investigation are presented here.

DEGREES OF SPROUTING.

During the past season various degrees of sprouting were observed in affected crops. A number of ears with sprouted grain were collected from a crop in stook. Half of these were placed in a stack and left there for eight weeks. The other half was hand-threshed and the grain sorted out into four groups A, B, C, and D according to the length of the sprouts. The description of the degrees of sprouting is as follows :—

Group A : All grains sprouted and showing green shoots over ½ in. long. There was also a great development of roots.

Group B : With green shoots ¼ in. to ½ in. long, and extensive root-development.

Group C : With small green shoots under ¼ in. long and less development of roots than A and B.

Group D : With no sign of green shoots, but the shoot had just broken the surface of the grain. Roots were developed slightly in some cases.

The threshed grain was air-dried for different periods, and the laboratory and field germinations obtained. These are given in Tables I and II.

Table I.—Laboratory Germination of Air-dried Sprouted Samples.

Group.	After Six Days' Drying.	After Fourteen Days' Drying.	After Twenty-one Days' Drying.	After Thirty Days' Drying.
	Percentage.	Percentage.	Percentage.	Percentage.
A	90·0	77·0	57·0	57·0
B	90·0	84·5	60·0	59·0
C	95·0	93·0	80·0	80·5
D	97·0	96·6	95·0	94·0

Table II.—Field Germinations of same Samples of Sprouted Wheat after Twenty-one Days' Air-drying.

Group.	Number of Seeds sown per Row.*	Field Germination, sown 25th February.	Field Germination, sown 4th May.
		Percentage	Percentage.
A	100	22·0	4·0
B	100	23·0	7·0
C	100	25·0	11·0
D	100	34·0	24·0

* Duplicate rows. Counts made fourteen days after sowing

From Tables I and II it is observed that as the grain dried out the laboratory germination decreased until constant after twenty-one days. The grain showing the least sprouting—viz., Group D—revealed a high laboratory germination, but, when sown in the field, the seedling establishment was low. The field germination of the other groups when sown at the usual time of autumn sowing—viz., early in May—was very low.

In the case of the sprouted wheat stacked for eight weeks before threshing, the germination results are shown in the following table.

Table III.—Germination of Sprouted Grain after being in Stack for Eight Weeks.

Group.	Laboratory Germination	Field Germination, sown 4th April	Field Germination, sown 4th May.
	Percentage	Percentage	Percentage.
A	58·0	11·0	3·0
B	64·0	13·0	4·0
C	83·0	16·0	8·0
D	96·0	40·0	21·0

In this case the field germination of the stacked sprouted wheat was slightly lower than where the grain had been air-dried, while the laboratory germinations were about the same.

Commercial Machine-dressed Seed.

It must be realized that the data given above refer to seed in which all the grains were sprouted to some extent. Such a condition would not be likely to occur in a commercial line of seed wheat—there the proportion of slightly sprouted grains (Group D) might be only a quarter or less. In addition, it is possible to remove the badly sprouted

grain from a line of seed by machine dressing. Several commercial-dressed lines of seed wheat harvested from sprouted crops were examined, with the following results :—

Table IV.—Germination of certain Commercial Lines of Machine-dressed Seed Wheat harvested from Crops showing some Degrees of Sprouting.

Sample No.	Sprouted Grains in Dressed Samples.	Laboratory Germination.	Field Germination, sown 1st April.	Field Germination, sown 4th May.	Difference between Laboratory and Field Germination. (May).*
	Percentage	Percentage.	Percentage.	Percentage	Percentage.
1 (Tuscan) ..	10·0	91·0	88·0	81·0	−10·0
2 (Cross 7) ..	12·0	92·0	85·0	80·0	−12·0
3 (Tuscan) ..	..	90·0	86·0	80·0	−10·0
4 (Cross 7) ..	13·0	89·0	84·0	76·0	−13·0
5 (Tuscan) ..	..	87·0	80·0	75·0	−12·0
6 (Tuscan) ..	18·0	86·0	80·0	73·0	−13·0
7 (Jumbuck) ..	23·0	75·0	70·0	68·0	− 7·0
8 (Cross 7)† ..	..	100·0	95·0	92·0	− 8·0
9 (Tuscan)† ..	..	99·0	95·0	90·0	− 9·0

* Figures indicate the difference between field establishment, sown 4th May, and laboratory germination

† Samples 8 and 9 represent *unsprouted* 1936 seed from crops harvested and threshed before damage by rain

From Table V one concludes that the dressed commercial seed on the market, harvested from sprouted crops, has a lower germination capacity than seed harvested before flood damage, and that the laboratory germination gives a fair idea of the value of the seed. The laboratory and field germinations of these commercial samples are not unsatisfactory, and about 10 lb. to 15 lb. of seed additional to the normal seeding would make up for the lower germination.

EFFECT OF SEED PICKLING ON COMMERCIAL SEED FROM SPROUTED CROPS.

In this trial a line of wheat and a line of barley machine-dressed, but harvested from sprouted crops, were examined. In each sample odd sprouted grains were noted. The seed was pickled as shown below, and the germination figures are shown in the following table :—

Table V.—Effect of Seed Treatments on the Field Germination of Lines of Commercial Wheat and Barley Seed harvested from Sprouted Crops

Seed Treatment.	Wheat.	Barley
	Percentage.	Percentage
Untreated seed	79·0	88·0
Hot water	70·0	72·0
Formalin	14·0	40·0
Clark's Wheat Protector ..	55·0	82·0
Ceresan	79·0	87·0
Copper carbonate	77·0	88·0

The dry-dust pickles have had little effect on the germination of those sprouted lines of seed, while wet pickles, particularly formalin, have materially decreased the germination of the seed.

VINE-CULTURE UNDER GLASS.

(Continued.)

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FIRST SEASON'S TRAINING.

When the young vines were cut back during the winter, at least two buds should have been left for each rod wanted. If the vine is to be trained to a single rod two buds are sufficient, but double that number will be required if two rods are to be worked up. The reason for this is that many things may cause the loss of a young shoot, hence an extra bud should be kept in case this happens.

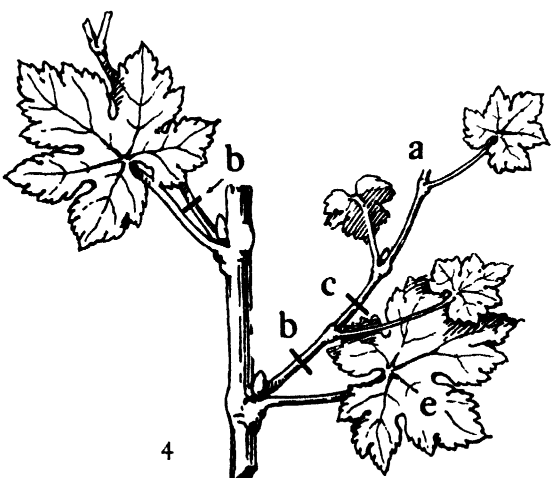
When sufficient growth has been made to enable it to be done, the leaders required should be loosely tied to the stakes previously mentioned, and when these leaders are safely established the spare shoots can be rubbed off or pinched back. When the leaders reach the wire they should be tied to it, the tying being loose to allow for the swelling of the rod. They should, in fact, be slung rather than tied under the trellis. Some incautious people train the rods over the horizontal trellis, which is now seldom used, but this is a very great mistake. When the rods are below the trellis they can be taken down for pruning and cleaning; if they are above the trellis these operations are rendered difficult, and cannot be properly performed. When the rods are underneath it is also much easier to tie the laterals to the trellis, as these always grow up towards the glass, while if their base is above the trellis it is sometimes a difficult matter to bring them down. It is a good plan, with very strong growers, to sling the rods on hooks a few inches below the trellis. This greatly facilitates the tying of the laterals.

It has already been stated that the vine makes its strongest growth at the top. This occurs not because of the height, but because this portion is the extremity of growth. Precisely the same thing occurs however many rods a vine may have. Unchecked growth draws sap to itself, and to some extent weakens other parts less favourably situated on the vine. This principle must be kept in mind, as it is a guide in the necessary control of the young growths.

If a vine in its first year were allowed to grow without check, the lateral growths would develop almost as strongly as the leader, and this would result in a very poor growth of rod. It is therefore necessary to check the lateral growths for the purpose of strengthening the rod. The laterals must not, however, be entirely suppressed, because this would cause the buds on the leader to break, which is not desirable as they are wanted to produce the laterals for the next season. Although the laterals must be left they must not be allowed to extend far, otherwise they would draw too much sap from the rod, and the buds on the main rod at the base of each lateral would not be properly developed. In addition to this evil there would be crowding of foliage, which must be avoided; all large leaves must have room to develop so that their surfaces may be exposed to the light. A few good well-spaced leaves are of greater benefit to the vine than any number of smaller and crowded leaves.

When the young vine gets fairly into growth it advances rapidly. The leader should be loosely tied as becomes necessary. Care in handling is necessary or the leader may be broken. The tips of the laterals should be pinched off when they have made three to four leaves; sublaterals when they have made one leaf. The points of the laterals will break again. These breaks should be pinched after making one leaf, and all future breaks from the laterals and sublaterals should be similarly treated. This plan of stopping is to be continued for 6 ft. or 7 ft. of the rod's length, and at this height the top of the leader should be pinched off. This will cause a temporary check in extension and will strengthen the lower part. A new leader will soon start; it should be allowed to extend at will, nor should the laterals it makes be pinched. The growth may extend so as to fill all space, but should not become a tangled mass. Enough should be removed to prevent this, as over-crowded leaves cannot fully perform their functions. Young vines that do well are able to fill a fair-sized house with growth, and the treatment here advised is based on the assumption that they will do so.

By the end of February the portions of the rods on which the laterals have been checked should have assumed a brown colour, a sign of ripening or maturity. Early in March the laterals on these portions should be cut back to their base; this will leave no lateral growth, but at each joint there should be a good leaf on the main rod. Each leaf influences the bud at its base—nourishing it and bringing it to maturity. If any of these leaves have been accidently lost the lateral at that point should not be entirely removed, but should be shortened to one leaf.



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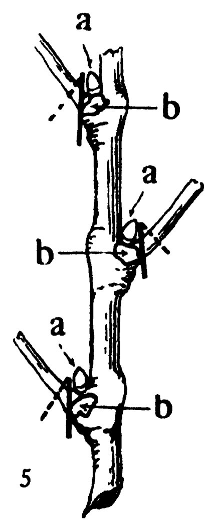

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FIG. 4. YOUNG GROWING ROD.

(*a*) Where the laterals are first pinched; (*b*) where the lateral is to be cut back to in March; (*c*) where lateral should be cut in March if the large leaf at its base has been lost.

FIG. 5. WINTER PRUNING FOR A YOUNG ROD.

(*a*) The buds to form future bearing-laterals; (*b*) the wrong way to prune—the dotted line shows the right way.

During the month of May, the vinery should be ventilated as freely as possible. Any growth made at this time is of no value ; it, however, may be detrimental. The chief object now is to get the canes well ripened. The leaves should fall in June and pruning should be at once attended to. Leaves may be holding on late laterals after all others have fallen, but pruning should not be delayed for these, as they are of no consequence. Late pruning causes the vines to bleed, and if bleeding is excessive it seriously weakens the vines. The length of rod to be left depends on its strength. It may be as thick as one's thumb, and, if so, 5 ft. may be left ; if as thick as the forefinger, 4 ft. may remain ; while 3 ft. is ample for weaker rods. The stronger rods may be allowed to carry a light crop the next season, say, a bunch to every other lateral. It may be noted that if the practice of former times were followed these vines would have been cut back again to the plate or to the bottom wire.

Manuring.

It is a common custom to utilize the vinery for tomato-growing until the vines are well advanced. In such cases, if the vines are planted inside the house, they will get their share of the fertilizers and water used for this crop, and no special feeding is necessary. If the vines make good growth the roots will soon reach the outside border. If planted outside, then as soon as growth has fairly started a light mulch of manure should be applied. The mulch should not be given at too early a period of growth, however, as the warmth of the sun is required to start the vines, and mulching would shut this out. By the time the vines are in good growth the days will be longer and sun heat greater, causing the surface soil to dry quickly and the vine-roots to go down in search of moisture. It is of great importance to prevent this. The roots should be kept as near the surface as possible, for, if what may be termed the foundation roots are deep down, future roots will go deeper still unless drastic steps be taken to attract them to the topsoil. If the roots are deep down not only do they lose the benefit of the good soil in the border, but they are likely also to get into cold, sour soil, resulting in several evils, which will be dealt with later on. A mulch serves to retain moisture in the topsoil so that the roots are encouraged to work in it.

It may be well to cite a personal experience of the effect of a mulch. This was a case where vines had been planted two years and had made good growth. On examining the border no roots could be found in the top spit. They had gone straight down. The border was fully exposed to the sun and situated on a hillside. Water could not lie in the subsoil, which was of pure clay. When the vines had got a good start, and before dry weather set in, a mulch of about 10 in. of fermenting stable manure was given. By the end of the season what was left of the manure was mostly a black mould. Roots had come up and even entered the manure, while the border itself was matted with roots, and could only be loosened lightly with a fork. During the following eight years this border could not be dug, it being possible merely to loosen the surface to take out weeds. Each year a light mulch was given and some fresh loam added to the border.

The mulch on the border does not supply moisture : it merely enables the surface soil to hold it ; watering may therefore be required at times. Liquid manure should not be given to a young vine, which having a new border to work in, will find all it requires.

Ventilation.

Where tomatoes are grown inside, treatment will, of course, be adapted to that crop, but the requirements of the two kinds of plants are in some respects different. Tomato-houses are generally, and quite rightly, kept as dry as they can be ; grapes like more moisture. This is a reason why tomato-growing should be discontinued as soon as the vines have reached the stage of producing a fair crop. The young vines should be well syringed at closing-time, or they may become attacked by red spider. Where the vines alone are cultivated in the house the top ventilators should be opened early in the morning so as to secure a movement in the atmosphere to carry off moisture that has condensed during the night. The bottom ventilators should not be opened until the moisture on the leaves has been dispersed, otherwise the plants become more susceptible to the attack of mildew. When the night moisture has disappeared the floor may be damped down so as to create what is termed a buoyant atmosphere, a condition in which the vine flourishes.

It may seem strange to advise getting rid of the night moisture because of the fear of mildew, and then damping down. The explanation is that condensed moisture on the leaves is in the form of globules of water. If the sun shines strongly on the house before the water is dispersed very rapid evaporation is caused. This lowers to nearly freezing-point the temperature of the spot on which the globules of water are seated, and mildew ensues. Rapid evaporation is also caused by the admission of a current of air, with the same result ; this is why the bottom ventilators should not be opened while the leaves are wet. The effect of the wind on moisture situated on a body is easily understood by the experience of bathers. One may come from water that is much colder than the atmosphere, yet shiver with cold. This is because the wind, together with the heat of the body, causes rapid evaporation, and consequently a very much lowered temperature on the skin. Much the same phenomenon occurs on vine-leaves. On the other hand, water thrown on a floor rises as vapour and tempers the atmosphere, but does not settle on the leaves.

During the spring the house should be closed before the sun has quite ceased to shine on the roof, and the vines then should be well syringed. This must be done in a thorough manner so that the rods get their share as well as the leaves. A thorough syringing in the evening and prevention of an arid atmosphere during the day are usually sufficient to prevent attacks of red spider and thrip. After the evening syringing the vines and house will be wet, but this state should not last long. If the house has been closed while the sun is still on the roof the temperature will have risen a few degrees, and this extra warmth will cause a good deal of the moisture to be dispelled as vapour. On dull or rainy days no damping-down or syringing should be done, as the atmosphere will be damp enough without it.

THE SECOND SEASON'S TRAINING.

The establishment of the vines, treatment during the first season, and the first winter pruning have already been dealt with. In the following season strong vines may be allowed to carry a little fruit, but the main purpose should be the extension of the rods. General

treatment—stopping growths, &c.—should be the same as for the previous season, except that where laterals are carrying fruit a different system of stopping is necessary, which will be dealt with later on. With regard to the length of rod to be left at the second winter pruning, opinions and practice among good cultivators vary greatly. In earlier days the usual custom was to work the rods up slowly, heavy cutting-back each season being the rule. For a good many years, however, many first-class growers have abandoned the old plan, maintaining that where vines make good rods they are quite able to carry some fruit, and that nothing is gained by cutting them back, and, further, that any harm done is caused by overcropping the young rod rather than by not cutting it back. If really good growth is made, resulting in stout rods, a length of 10 ft. or 12 ft. may be left at pruning-time, but such a length of new rod should rarely be allowed to carry, during the next season, more than one bunch to every other spur. Weaker rods should be cut back farther, as previously mentioned.

(To be continued.)

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 23rd April, 1936, to 21st May, 1936, include the following of agricultural interest:—

No. 74305: Incubator; H. J. L. Williams. No. 74338: Dipping sheep; R. E. Picker. No. 73383: Water-sprayer; W. J. G. Craig. No. 74423: Milk-cooler; F. W. Davenport. No. 75201: Cart; A. and H. A. Deas and J. Piper. No. 75354: Wool-cleaning machine; Fitger California Co. No. 75789: Harrow; R. M. Wilson. No. 75790: Cleaning wool; Chemicals Precipitation Pty., Ltd. No. 73920: Wheelbarrow; J. S. Whitaker, S. C. Gurney, and A. H. Balderston. No. 74062: Hay-stacking device; A. C. Anderson. No. 74295: Harrow-tine; R. M. Wilson. No. 74634: Aerating lawns, W. Hargreaves and Co., Ltd., and W. Hargreaves. No. 74686: Manure-distributor, J. H. Mason. No. 75538: Shearing-machine; Chicago Flexible Shaft Co. No. 75762: Egg-carrier box; K. K. Newsom. No. 75880: Gate; W. H. Bennett.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

THE PRIMARY PRODUCTS MARKETING ACT, 1936.

THE Primary Products Marketing Act, 1936, which came into force on 15th May, is an Act to make better provision for the marketing of dairy-produce and other primary products so as to ensure for producers an adequate remuneration for the services rendered by them to the community. The Act is divided into three parts—viz., Part I, Administration , Part II, Marketing of Dairy-produce ; and Part III, The New Zealand Dairy Board.

PART I : ADMINISTRATION.

By this Part a member of the Executive Council may be appointed by the Governor-General as the Minister of Marketing, and a Department of State called the Primary Products Marketing Department is established. The Department, under the control of the Minister, is charged with the administration of the Act.

Provision is made for the appointment of a Director of Marketing, who shall be the administrative head of the Department. One or more Assistant Directors of Marketing may also be appointed, and such other officers as may from time to time be considered necessary. Any member of the Executive Commission of Agriculture may be appointed to be the Director or Assistant Director of Marketing, and any officer of the New Zealand Dairy Board or any person who has technical or other expert knowledge of the dairy industry may be similarly appointed a permanent officer of the Department.

The principal functions of the Department are to make all necessary arrangements with respect to—

(a) The acquisition on behalf of the Crown of any primary products in accordance with the Act or any other lawful authority that may be conferred :

(b) The marketing in New Zealand or overseas of primary products whether acquired by the Crown or not.

After the coming into force of the Act no contract for the carriage by sea of any primary products intended for export shall be made except by the Minister or in conformity with conditions approved by the Minister. The functions of the Executive Commission of Agriculture are transferred to the Department, and the Executive Commission of Agriculture shall be abolished on a date to be fixed by the Governor-General in Council. While the Commission remains in existence it shall have such powers as may be delegated to it by the Minister.

All the functions of the Department may be exercised by the Minister, who may delegate to the Director of Marketing such of his powers as he thinks fit. Any such delegation may be made generally or in relation to any particular matter or may be made subject to such conditions and restrictions as the Minister thinks fit. Similarly, any Assistant Director of Marketing may, with the written authority of the Director of Marketing, exercise any of the powers of the Director. The Director of Marketing acting with any Assistant Director or any other person or persons appointed by the Minister shall have all the powers of a Commission of Inquiry appointed under the Commissions of Inquiry Act, 1908, for the purpose of obtaining any information deemed necessary or of value to enable the Department to fulfil its functions or to enable the Government to determine whether the functions of the Department should be extended or varied.

For the purposes of the Act an account to be known as the Dairy Industry Account shall be established at the Reserve Bank of New Zealand. The Government has unlimited power to borrow by way of overdraft from the Reserve Bank moneys in aid of the Dairy Industry Account, and the account may be overdrawn accordingly. Subsidiary accounts may also be opened at the Reserve Bank or at any other bank in New Zealand or elsewhere. All moneys received from the sale of dairy-produce shall be paid into the Dairy Industry Account, together with all other moneys lawfully payable into the account. All moneys payable by the Crown in respect of the price of dairy-produce or the freight, insurance, storage, or marketing of dairy-produce

and all other expenditure incurred in the administration of the Act, including the salaries and allowances of officers, shall be payable out of the account. An annual report on the operations of the Department as at 31st July, together with statements of account for the preceding twelve months, must be prepared and presented to Parliament. All regulations required for the purpose of giving effect to the Act may be made under the powers conferred by section 27 of the Agriculture (Emergency Powers) Act, 1934.

With a view to the promotion of reciprocal trade the Minister of Marketing is empowered to arrange the terms of provisional trade agreements with the Governments of other countries, negotiating first with the accredited representatives of the United Kingdom Government, then with those of the Government of any other part of the British Empire, and finally with the accredited representatives of the Government of any other country. The basis of any such agreement shall be that, in consideration of the purchase of any primary products of New Zealand by the Government of the overseas country or of the establishment or maintenance in such country of favourable marketing-conditions for any primary products of New Zealand, the New Zealand Government will undertake to arrange through the Reserve Bank for the whole or a substantial part of the financial credits thereby established in such country to be utilized in the purchase of approved goods or classes of goods produced or manufactured in that country.

PART II: MARKETING OF DAIRY-PRODUCE.

For the purposes of Part II the term "dairy-produce" is defined to include milk, cream, butter, cheese, and all other products of milk or cream, whether derived by manufacturing processes or otherwise. It also includes any other products of a kind derived from the operations usually carried on in conjunction with dairy-farming operations (such as the rearing of calves and pigs), whether such products are actually produced on dairy-farms or elsewhere.

For the present, Part II of the Act applies only to butter and cheese that is manufactured from milk or cream delivered to a dairy-factory on, or at any time after, 1st August next, but the Minister may, by notice published in the *Gazette*, apply the provisions of Part II to any other kind of dairy-produce. Part II does not apply to dairy-produce that is both produced and consumed in the Chatham Islands Wherever in the notes that follow, so far as Part II is concerned, reference is made to dairy-produce, it should be noted that for the present the term means butter and cheese so manufactured. The Minister has full authority to make such arrangements and give such directions as he thinks proper for the handling, pooling, transport, and storage of dairy-produce, the shipment of dairy-produce intended for export on such terms and in such quantities as the Minister thinks fit the insurance against loss of dairy-produce and generally for all matters necessary in the exercise of any powers expressly conferred upon him by the Act.

All dairy-produce intended for export shall become the property of the Crown as soon as it is placed, with the concurrence of the Department, on board any ship for export, but the Minister may, by notice published in the *Gazette*, determine that the ownership shall pass to the Crown at any specified time prior to shipment. Upon the ownership of dairy-produce passing to the Crown the price to be fixed in accordance with Part II shall become payable to the owner of the dairy-factory or other person entitled thereto after deducting the amount of the levy (if any) payable to the New Zealand Dairy Board. The prices to be paid for dairy-produce exported shall be fixed by Order in Council. Different prices may be fixed for different kinds of dairy-produce, or for different grades or qualities of the same kind of produce, or for the same kind or grade or quality of any dairy-produce by reason of any special conditions or circumstances which in the opinion of the Governor-General warrant the fixing of different prices. The prices to be fixed for dairy-produce manufactured on or after 1st August and exported on or before 31st July, 1937, shall be fixed after taking into consideration the prices received in New Zealand for dairy-produce of the

same or approximately the same kind, grade, and quality exported during a period of from eight to ten years prior to 31st July, 1935. The prices to be fixed for dairy-produce exported after 31st July, 1937, shall be such that any efficient producer engaged in the dairy industry under usual conditions and in normal circumstances should be assured of a sufficient net return from his business to enable him to maintain himself and his family in a reasonable state of comfort, and shall be so fixed after taking into consideration the following matters:—

(*a*) The prices fixed for dairy-produce exported before 31st July, 1937:
(*b*) The necessity in the public interest of maintaining the stability and efficiency of the dairy industry:
(*c*) The costs involved in the efficient production of dairy-produce:
(*d*) The general standard of living of persons engaged in the dairy industry in comparison with the general standard of living throughout New Zealand:
(*e*) The estimated cost to the Department of marketing the dairy-produce concerned:
(*f*) The cost of the general administration of the Act:
(*g*) Any other matters deemed to be relevant.

With regard to dairy-produce intended for sale for consumption in New Zealand, the Minister may determine that the ownership thereof shall pass to the Crown as and when the Minister shall specify by notice published in the *Gazette*. Alternatively, the Minister may determine that the Department shall control the marketing of such dairy-produce but that the ownership thereof shall not pass to the Crown. At any time after the fixation of prices for dairy-produce exported or intended to be exported prices may be fixed by Order in Council in respect of dairy-produce intended for local consumption, whether it has been or is intended to be acquired by the Crown or is sold or intended for sale otherwise than to the Crown. In fixing the prices to be paid to any dairy company for dairy-produce manufactured by it (whether such price is to be paid by the Crown or by any private purchaser) the general purpose shall be to assure to the producer a net return from his produce equivalent to the return that he would have received if such produce had been acquired by the Crown for export. In fixing other prices of dairy-produce the general purpose shall be to ensure that the consumer will be able to obtain the produce at a reasonable price, and that the retailer and other persons engaged in the distribution of the produce will receive a fair and reasonable remuneration for efficient services. Subject to the foregoing general conditions the Governor-General may fix such prices for dairy-produce intended for sale for consumption in New Zealand as he thinks fit. The validity of any Order in Council fixing the prices for dairy-produce shall not be questioned on any ground whatsoever

If after prices for dairy-produce have been fixed any dairy-produce is manufactured of a kind, grade, or quality for which prices have not been fixed, or does not conform in all material particulars with the requirements of the Department, that dairy-produce may be sold only in accordance with the direction of the Minister. Every person who, whether as principal or agent and whether by himself or his agent, sells or disposes of dairy-produce otherwise than in accordance with the directions of the Minister or at other than the appropriate price for that dairy-produce commits an offence against the Act. The giving or offering of any unauthorized rebate, refund, discount, allowance, premium, or other valuable consideration in relation to the sale of dairy-produce in respect of which prices have been fixed is also an offence. Liability for the commission of an offence against the Act is a fine of £200 in the case of an individual and £1,000 in the case of a company or other corporation.

PART III: NEW ZEALAND DAIRY BOARD.

Part III of the Act comes into force on 1st August next. On that date the New Zealand Dairy Board is to be reconstituted The present Government members shall be deemed to have vacated their offices, and thereafter

the Board shall consist of five members—viz., the present four producer members and one member as the representative of the Government. Any one of the members vacating office may be appointed to be the Government representative on the Board.

The present powers of the Board with respect to the control of dairy-produce intended for export or for sale for consumption in New Zealand are repealed as from 1st August. Thereafter the Board shall not exercise any of its powers, functions, or discretions except with the approval of the Minister of Marketing. The functions of the Board with respect to dairy-produce, not being dairy-produce to which Part II of the Act applies, may at any time after 1st August next be exercised by the Minister, or by the Board with the approval of the Minister, as if Part II of the Act applied to such dairy-produce, whether or not such dairy-produce has been exported before the passing of the Act and has not been finally disposed of or is exported after the passing of the Act. Any such approval may be general or special, and may be absolute or subject to such conditions as the Minister thinks fit to impose. All contracts of the Board subsisting on 1st August next become contracts of the Crown in so far as they relate to the storage, insurance, or freight of the dairy-produce to which Part II of the Act applies. The property of the Board in the National Fern Leaf design registered in the United Kingdom is transferred to the Crown with effect from that date.

—*A. E. Morrison, Solicitor, Department of Agriculture, Wellington.*

SEED-POTATO CERTIFICATION.

EXTENSION OF SCHEME TO CERTAIN DISTRICTS IN THE NORTH ISLAND.

IT has been decided to extend the scheme of Government certification of seed potatoes, at present operating only in the South Island, so that in the 1936–37 season crops being grown in certain localities in the North Island may also be included in the scheme.

The district to which certification is to be extended is that potato-growing area to the north of Marton, and extending as far as the Ohakune district. Any crop in this district, in order to be eligible, must be grown at an altitude of not less than 1,500 ft., while the following conditions must also be complied with before an area can be considered for certification :—

(1) The seed being planted must have been certified by the Department of Agriculture in the "Mother" class.

(2) The minimum acreage of any one area will be 1 acre.

(3) Applications for certification in the ensuing season must be in the hands of the local Instructor in Agriculture at Wanganui on or before the 31st August next.

(4) It will be necessary for the local Instructor in Agriculture to collect a representative sample of 200 tubers of the seed being planted. This sample will be grown in the Department's trial plots in comparison with other lines of the same variety.

(5) The fees payable in connection with the certification of any area are as follows :—

 (*a*) A sample trial fee of 10s. which must accompany the grower's application. (This fee covers all lines entered by one grower on one farm.)

 (*b*) A field inspection fee at the rate of 2s. 6d. per acre, with a minimum of 10s., which must be paid prior to crop inspection, and on or before the 20th December in each season.

(6) In the meantime no seed will be certified in other than the "Commercial" class.

Growers interested in the scheme may obtain further information, together with application forms, from any officer of the Fields Division of the Department of Agriculture.

—*Fields Division.*

CITRUS INDUSTRY.

IN recent years there has been a considerable increase in the area devoted to citrus-culture. The total area is estimated to be in the vicinity of 1,884 acres, comprised of lemons, 1,300 acres; and oranges, 584 acres. At the 1st October, 1934, there were 85,973 lemon-trees and 37,399 orange-trees in registered orchards, and at the same date the following year the respective totals were 91,032 and 40,909 trees.

From the orchard registration records the following table showing the number of registered citrus-growers in the Dominion, classified in districts according to size of orchard, as at 1st October, 1935, has been prepared:—

Table showing the Number of Registered Citrus-growers in the Dominion classified in Districts according to Size of Orchard as at 1st October, 1935.

Group, Number of Trees ..	1–50 Trees.		51–350 Trees.		351–1,000 Trees.		Over 1,000 Trees.		Totals of Trees.
District.	Number of Growers.	Number of Trees.	Number of Growers.	Number of Trees.	Number of Growers.	Number of Trees.	Number of Growers.	Number of Trees.	
Whangarei	208	2,427	55	7,879	37	18,663	4	8,278	37,247
Auckland	732	10,650	241	29,734	18	9,332	..	..	49,716
Hamilton	149	842	5	497	..	..	..	..	1,339
Tauranga	281	2,886	88	13,253	17	8,826	2	3,212	28,177
Gisborne	180	1,849	17	2,363	1	420	..	..	4,632
Hastings	244	2,197	21	2,407	..	..	..	..	4,604
Masterton	13	70	..	..	..	..	..	..	70
Palmerston North ..	215	1,134	3	267	..	..	..	..	1,401
Wellington ..	23	93	1	60	..	..	..	..	153
Nelson	71	454	14	1,530	1	450	..	..	2,434
Mapua	36	317	6	457	..	..	..	..	774
Motueka	65	370	6	593	..	..	..	..	963
Blenheim	99	367	..	..	..	..	..	..	367
Christchurch ..	23	51	..	..	..	..	..	..	51
Dunedin	2	13	..	..	..	..	..	..	13
Trees	..	23,720	..	59,040	..	37,691	..	11,490	131,941
Growers	2,341	..	457	..	74	..	6	..	2,878
Percentage of total number of growers	81·34	..	15·88	..	2·57	..	0·21	..	..

—*W. K. Dallas, Citriculturist.*

As a result of conflicting reports on the ability of a super-lime mixture to eliminate the bad effects of super alone on the germination of turnip-seed, an investigation into the ability of ground limestones to revert the water-soluble phosphate into water insoluble phosphate, but still leaving the phosphate in a form available to plants, has been carried out. The presence of sufficient moisture is one of the main essentials to efficient reversion. In a dry condition very little reversion takes place in spite of several months in intimate mixture. In this case reversion cannot take place until the mixture is applied to the soil. If the soil is dry and the dry superphosphate-lime mixture is sown with turnip-seed considerable germination injury may take place. If, however, water is added to the mixture prior to sowing rapid reversion takes place, and if not too large amounts of water are added the mixture, after reversion, will be in a dry state suitable for drilling. Fineness of grinding of the lime considerably affects the rate of reversion, but differences inherent in the original limestone are responsible for the greatest differences. For example, ground limestones from certain districts when used with superphosphate will correct the harmful effect of the superphosphate much more effectively than ground limestone from certain other districts, although the fineness of grinding and the total calcium carbonate ($CaCO_3$) may be practically the same.—*Report, B. W. Doak, Chemist.*

SEASONAL NOTES.

THE FARM.

Labour Economy.

OF prime importance is the share of farm returns available for the payment of the labour of the farmer and his employees, including possibly members of his family. The proportion of the farm returns available for the payment of labour is determined to a large extent by the efficiency of the labour itself. Observation and investigation have shown that some of the matters which contribute towards the efficient use of labour and which well may be given attention at this season are—

1. The work should be planned in advance.
2. There is a most suitable time for doing much work, and such work should be done on time. Most farm work can be done most quickly, most cheaply, and most effectively if it is done at the right time. The preparation of the land for seed-sowing and the control of weeds are striking instances.
3. Heavy crop-yields are commonly associated with high labour returns. This may be realized readily by comparing the net returns from a 10-ton an acre and a 5-ton an acre crop of potatoes—such a comparison illustrates the general position.
4. Heavy production of live-stock is commonly associated with high labour returns. As a rule the cow producing 360 lb of butterfat does not call for twice as much outlay in land, labour, &c., as does the cow producing 180 lb. of butterfat, and similarly the requirements of the sow producing fourteen pigs a year are not twice as great as those of the sow producing seven pigs a year—the latter is approximately the average figure.
5. Labour-saving equipment should be employed. Apart from the purchase of labour-saving machinery, this may call for the construction of suitably located ensilage trenches or pits. It may also call for alterations in pig-keeping layouts, &c.
6. The fields should be arranged so as to make possible the best use of crops and of machinery. To achieve this result with pastures, further subdivision often is advisable.
7. The farm business should be large enough to keep the available supply of labour fully and efficiently employed. Proper attention to this matter often would lead to increased arable cropping on both sheep-farms and dairy farms dominantly dependent upon grassland. Likewise, on many dairy farms it would lead to increased attention to pig-keeping, especially in conjunction with increased arable cropping.

No attempt has been made to arrange the above seven matters affecting labour economy in the order of their importance, which varies from farm to farm ; but the first and the seventh are probably of the greatest general importance, and this primarily because of the wide lack of attention to them.

Planning of Work.

Planning of farm work is a task of major importance, and it has been well established by experience that the greatest rewards in farming have gone to those whose operations are best planned. A good deal of useful planning may fittingly be carried out at this stage—*e.g.*, the preparatory work in the provision of reserves of feed for use in periods of scant growth of pastures. In this connection, of primary importance is the fact that often the provision of feed is based on the requirements of the class of stock of major importance while the needs of stock of less, but nevertheless considerable importance, are overlooked. For instance, on North Island dairy farms the cropping often seems not to take into account the needs of

pigs and of poultry, and similarly on South Island mixed farms on which grain crops and sheep are dominant, the needs of small dairy herds and of pigs are ignored ; this, in both Islands, with considerable detriment to net returns. This introduces consideration of the seventh matter mentioned above, the advisability of keeping labour fully and effectively employed.

Labour Utilization.

An important matter in labour utilization is the avoidance as far as possible of idle periods at one stage, and of overcrowded periods at another stage. In this connection it should be remembered the opportunity for improvement of farm income is often greater through changes in enterprise combinations than through improved methods within single enterprises. Dairying often strikingly illustrates this. It may be possible by pasture-improvement, top-dressing, &c., to raise the carrying-capacity to an extent which means too much work for, let us say, two full-time workers, but not enough work for three full-time workers. In such cases an advantageous procedure often is to give such additional attention to pig-keeping and special cropping as fully justifies the employment of three full-time workers. The special cropping is likely to react advantageously on the butterfat-production as well as on the pig-keeping. The total result is a better all-round economic position ; although the increase in butterfat-production and the pig-keeping as separate enterprises may not be economic, as an enterprise combination they are distinctly attractive.

General Cropping Work.

The working of land intended for cereals should now be given precedence. On the basis of experience it is customary to sow the greater part of the spring wheat area in August and September In some districts, especially in the North Island, good crops may be obtained from later sowings, but, as a rule, in the main grain-growing districts the yields are not so heavy from such sowings.

The sowings of oats as a rule should follow the sowing of wheat as opportunity offers. Good results often follow the sowing of black skinless barley in August.

A heavier amount of seed should be used with spring-sown cereals—*e.g.*, in the main South Island wheat-growing districts 1½ bushels to 1¾ bushels of Tuscan seed is accepted as suitable for autumn sowing, but 2 bushels or more are used for spring sowing.

Spring-sown cereals usually benefit from rolling of the ground after sowing, but, except in the case of light land, the rolling should be deferred until September or October, instead of being carried out immediately after drilling.

When autumn-sown cereals are to be utilized for chaff or grain, the final feeding-off generally should take place towards the end of August, but in the case of crops on such rich ground that " lodging " may be expected, it is of assistance in avoiding " lodging " to carry out the final feeding-off in September. Generally, after the final feeding-off, it is advantageous to give the crop a stroke or two of the tine harrows for the purpose of loosening the trampled soil and of scattering stock-droppings. Spring feeding-off of cereals should be done by stocking heavily for a short period when the ground is not excessively wet.

The remarkable increase in pig-keeping which has taken place is considered to be the forerunner of a further substantial increase, which will involve the growing of crops specially for feeding to pigs. Considerable field experience shows that mangels, swedes, chou moellier, and carrots are suitable for this purpose, and that these crops fed in considerable quantities to pigs in winter and early spring are giving quite attractive returns. Of these the mangel is specially worthy of consideration, both because of its high potential yield of suitable feed an acre and also because

of the fairly common belief that the mangel is in some way unsuitable for pigs. Relative to this the feeding of mangels as the only constituent of pigs' diet is not recommended, just as a diet of other feeds alone, such as swedes, is not recommended. But there is no reason to doubt the safety of either of these crops when fed judiciously. Actually fully matured mangels have been fed widely with success as a substantial portion of pigs' rations. In giving mangels and similar roots a place in the feeding of pigs abrupt changes should be avoided, and the quantities of such crops fed should be small at the beginning and increased gradually. Root crops and similar other crops such as chou moellier are approximately intermediate in character between concentrates and coarse feeds—a fact which must be kept in mind in feeding them to the best advantage. Detailed information may be obtained on application.

On many widely distributed North Island dairy farms handsome returns have been obtained in recent seasons from feeding to pigs maize, barley, and field peas grown on the farms on which they are used. Though it is probable that in certain dairying districts this practice would not be advisable, the experience already available indicates that it is advisable, at present prices for pig-products, over wide areas in the North Island, including ones in which but little or practically no cropping is being done. It is of importance that the adoption of the practice does not call for special outlay in equipment not ordinarily in use on dairy farms—barley and peas may be cut with the mower, and all threshing may be done, and that thoroughly, by pigs.

Italian rye-grass and Western Wolths, which often can be sown with good results at the end of August, serve as special forage crops suitable for the provision of hay or silage if necessary.

As far as possible grazing of established lucerne, especially during winter and early spring, should be avoided. Grazing necessarily causes consolidation, which favours the establishment of such plants as rye-grass and white clover, which thrive only at the expense of the lucerne. Harrowing of established lucerne, even though it is weedy, generally is inadvisable at this season unless the conditions allow one to lessen substantially the number or the vigour of the weeds without undue damage to the lucerne itself—this is quite unusual. In the main grass-farming districts the only harrowing that as a rule is effective in the control of weeds is one carried out about January or February, when the dry conditions, in conjunction with the rapid growth of the lucerne itself, lead to suppression of weeds disturbed by cultivation. It is considered that more harm than good has been done by indiscriminate cultivation of lucerne as a routine measure.

Seed-treatment for disease-control in spring-sown cereals should not be overlooked. Probably the treatment of oats and barley is more neglected than is that of wheat; it should be kept in mind that smut is decidedly objectionable in an oat crop which is to be chaffed, and that the Algerian oat is subject to smut. In recent years there have been some important developments regarding the seed-treatment of cereals. If seed-treatment is not done in the proper manner it is likely either not to bring about control of disease or to result in grave injury to the seed. Full information about suitable treatment is available from the Department of Agriculture.

Pasture Management.

A farmer who has not top-dressed already as extensively as is warranted may carry out top-dressing at this stage with every confidence that on suitable swards he will secure good results. Much benefit has resulted from top-dressing in July and August—indeed, the value of top-dressing was largely established by, and much of whatever top-dressing tradition

we have has been built mainly upon, winter and early-spring top-dressing. Ordinarily superphosphate should be used almost always at this season when an objective of the top-dressing almost invariably is an increase, as quickly as possible, in the feed available. And superphosphate is the quickest in action of the phosphatic fertilizers. Whether quickly acting nitrogenous fertilizers such as sulphate of ammonia should be used in addition to the superphosphate to stimulate growth still further, as was discussed in these notes in May, is a matter for each farmer to decide according to his own circumstances. Under some circumstances the use of other phosphatic fertilizers may be advisable, and at times the use of supplements to phosphates such as materials containing lime and potash may be profitable. Information about the use of these materials may be obtained from district officers of the Fields Division. As a rule the first consideration is the supply of phosphates.

Harrowing of pastures is commonly advisable in August, and if not done on fields on which animal manure is plentiful the spring growth of the pastures will be very uneven because of the development of patches of rank growth in the vicinity of the undisturbed droppings. It is not at all easy to deal satisfactorily with rank patches of grass-growth on farms carrying mainly "wet" stock, and so harrowing which obviates such patches is particularly useful.

Young pastures, and especially those sown with seed-mixtures designed to give swards as permanent as possible, should be treated with particular care during winter and early spring. Two faults to be avoided as far as is practicable are over-severe grazing and over-lenient grazing. The latter is particularly inadvisable if the sward contains a considerable proportion of Italian rye-grass which, if allowed, tends to outgrow and weaken more persistent valuable species in a sward Over-severe grazing, which readily leads to a setback to valuable species before they have properly established themselves, is much more likely than over-lenient grazing to happen in the spring The proper remedy for it, which should be kept in mind in any planning of work, is the building of adequate reserves of feed for use in winter and early spring.

Instead of waiting for improved drainage to enable a high-class mixture of the rye-grass - cocksfoot - white-clover type to be sown with success, it is sometimes advisable to establish species which yield satisfactory supplies of feed under badly drained conditions. This may mean using such species as meadow foxtail, *Poa trivialis*, *Lotus major*, strawberry clover, sweet floating-grass, *Poa aquatica*, &c , according to the conditions Detailed information about suitable plants for badly drained situations may be obtained from local officers of the Fields Division.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Pruning.

PRUNING which has not been completed should be pushed ahead as rapidly as possible to ensure its completion before spraying commences

The principles of refurnishing trees with new fruit-bearing laterals should be borne in mind. The older and more exhausted fruiting wood should be cut away and selected new lateral growth left to take its place in the fruiting sequence. The fruiting wood should be well spaced so as to avoid an undue density of growth to enable the buds to be exposed to light and air. This allows of more efficient spraying and favours greatly improved colour in the fruit at harvesting time.

All the prunings should be gathered and destroyed, and not left lying around or just gathered and dumped in a heap in some vacant area.

Planting.

Before planting is commenced it is desirable that the land should be thoroughly worked and adequate shelter provided.

The marking-out of new areas and the planting of the trees may now be proceeded with providing the condition of the soil is suitable. The trees should be firmly planted. If adequate shelter from strong winds has not been provided, stakes should be driven in alongside the trees, so that each tree may be supported by tying to the stake.

At planting a dressing of ½ lb. of blood-and-bone manure should be placed in the hole and then well mixed with the soil, as it materially assists the tree. Cultivation should be regularly attended to during the spring and summer months.

In the spring, when the buds are commencing to break, an application of ½ lb. of a nitrogenous manure assists in effecting a more vigorous growth in the young trees during their first year.

Manuring.

The application of phosphatic and potassic manures should be made prior to the deepest ploughing, while nitrogenous manures may be applied at a later period in the spring. The quantities per tree of a complete manure should approximate 1 lb. per bushel of the annual fruit-yield per tree—that is, for example, a tree averaging 4 bushels of fruit per annum would receive 4 lb. of manure. The manure-mixture should be comprised of phosphate (approximately) half, potash (sulphate) quarter, and nitrogenous fertilizer quarter, respectively, of the total content Where considered desirable, additional nitrogen may be added to the mixture.

As a nitrogenous manure promotes growth and leafage, it may be used to advantage on the poorer soils and where trees have become stagnant and lacking in sufficient new growth If nitrogenous manure is used to excess, however, sappy growth is promoted, with which is generally associated fruit of poorer colour and of soft texture, which is more liable to break down during storage. Such fruit is also more readily bruised by the handling received during harvesting operations and in transit to the market. As a general rule, peaches and nectarines require a greater amount of a nitrogenous manure than do apples, pears, and plums.

Potash, on the other hand, if used in excess, has an opposite effect, and may be used to advantage where trees are showing excess growth. By its use an improvement is secured in the quality of the fruit, the texture of which becomes firmer and better able to withstand handling during transit to market. The fruit will also hold up better during storage. If potash is used to excess the size of the leaves becomes restricted and the leaves readily fall, while growth is retarded. Our orchard soils which are in full cultivation seldom lack potash, and on this account only a relatively small amount is recommended.

Following the autumn ploughing, carbonate of lime, at the rate of from ½ ton to 1 ton per acre, should be applied to the cultivated surface of orchard soils considered to be deficient in lime.

General.

Where it is intended to rework trees during the spring by grafting, the scions of the desired varieties, if not already taken, should be selected now and heeled-in in a shady position.

The first spray of Bordeaux 5–4–50 should be applied to stone-fruit trees during the month of August.

Where adequate shelter has not yet been provided, the planting of shelter-trees should now be undertaken. A little care in setting out the shelter-trees in cultivated ground, together with a light dressing of manure followed by cultivation around the young trees during the spring and summer months, greatly assists the trees to become established and make good growth.

It is advisable to complete ploughing operations well before the fruit-trees commence growth, so that the roots are not unduly disturbed and damaged at the critical time of fruit-setting.

—*R. G. Hamilton, Orchard Instructor, Hamilton*

Citrus Culture.

Since the notes for the June issue of the *Journal* were written there have been quite a number of severe frosts in the Auckland district, and unless growers have acted upon the advice which has been given in the citrus notes from time to time relative to the use of heaters it is possible that considerable damage has been done to both trees and fruit It is very important that growers be prepared for visitations of this kind, and although these notes are too late to obviate possible damage, nevertheless they may serve as a warning to many and stimulate greater activity and preparedness in future seasons.

It is advisable to make a careful inspection of the crop in order to ascertain whether the fruits have been damaged Damage done to the trees is serious enough, but when the fruit is injured it is much more serious Frost injury causes the juice to dry out, leaves the fruit very spongy, and makes it unfit for marketing. If fruit of this kind is sold, the reaction of the consumer doubtless will be reflected in a decrease in the sales of New-Zealand-grown citrus fruits for quite a long time, and every grower will be affected thereby

It is probable that preparations are well in hand in some orchards for the coming planting season, but there may be some who have overlooked consideration of a number of details The advice given herein from time to time should be followed, and no operation, however small, should be neglected. It is very advisable to keep in mind the danger of planting until adequate shelter has been provided and the soil has been thoroughly prepared. The delay of a season, or even more, to enable the shelter-trees to become established and the land drained and cultivated is not lost, but rather it is time gained, as it results in the trees growing very much more quickly and coming into profitable bearing sooner

The attention of the grower is directed to the notes in the June issue of the *Journal* in regard to the picking and handling of the fruit. There is ample evidence that quite a large proportion of the moulds that are so troublesome in the curing and grading sheds can be traced to carelessness by the grower in harvesting and subsequent handling and transport of the fruit to the sheds. It is imperative, therefore, to exercise the greatest care, to use gloves when picking, and to see that the finger-nails are kept closely trimmed. Cut the fruit-stalk back neatly to the button, place the fruit carefully into boxes, see that the cases are not filled too full, and that they have no rough edges or protruding nails, and last, but not least, the vehicle used to convey the fruit to the shed should run as smoothly as possible, so as to avoid bruising of the fruit in transit from the orchard Attention to this materially assists in removing some of the principal causes of some of the losses which are being experienced with our fruit in a number of packing-houses.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Breeding Notes.

No time should now be lost in making up the breeding-pens for the coming season if this has not already been done. Though eggs generally prove fertile from seven to nine days after stock have been mated, it is advisable to have the birds mated up some little time before eggs are required for incubation. As a general rule, one male bird to each eight or ten hens of the heavy breeds and one male to twelve hens of the light breeds gives good results.

Where flock-mating is practised—*i.e.*, where several males are mated to a flock of hens—it is well to put in an extra male to start with, as very often a male is lost through fighting.

The best results usually are obtained when second-year hens are mated to well-developed cockerels. Third, or even fourth, year hens, if active and of good type and in good breeding-condition (not overfat), give fine results. Some breeders like the older birds as breeders, but, owing to the fact that the older hens take a longer time to come back to laying after the moult, the majority of poultry-keepers prefer the second-year hens.

Although it is advisable to get the hatching over within a reasonable time, it is unwise to place in the breeding-pens hens or males that are not up to standard. In some cases where trouble has been experienced with the hatching and rearing, an examination of the breeding-stock has shown that the owner, in his desire to increase his flock and shorten the breeding season, to some extent has sacrificed quality for quantity.

The primary cause of many poultry ailments and disease is breeding from immature or inferior stock, and the best way to avoid disease is to place in the breeding-pens only birds of undoubted vigour and constitution. Where trouble has been experienced in the past, by taking extra care in the selection of the breeding-stock, the owner will go a long way towards correcting matters.

At times when there is a tendency for a poultry-keeper to become too satisfied with his own birds more visits to other farms, especially where quality is a strong feature, and careful comparison of the stock, are well worth while.

The most successful poultrymen are amongst those who have gained their knowledge slowly along the road of practical experience, and very often they have been greatly helped by closely observing other successful men who have always taken extra care in the selection of their breeding birds. A person may start off with little experience, on fresh ground and with a few good birds of a strain that has taken years to build up, and obtain wonderful results for the first year or so, but very often the returns in subsequent years are not so good. This generally is due to the fact that the ground is becoming tainted, and that there has been an endeavour to increase his flock too quickly before he has had time to gain sufficient experience in the art of selecting breeding-stock.

Fresh Blood.

Those requiring fresh Leghorn blood for next season's breeding-pens may secure a change from this Department's Wallaceville Poultry Station during the coming season. Last July this Department imported from the New South Wales Government one hundred White Leghorn and one hundred Langshan eggs, and cockerels reared from the Leghorn eggs are now mated to some Wallaceville hens, and sittings of eggs, in limited quantities, *not exceeding five dozen* for any one order, may be procured at 6s. 6d. per dozen, postage free. Those requiring eggs from these matings should apply early to the Poultry Overseer, Veterinary Laboratory, Private Bag to Wallaceville, Wellington.

Some Brooding Notes.

Methods of artificial brooding have been much improved of late years, and to-day the most popular brooder in this country is the canopy-shaped type of electric or lamp-heated brooder. However, success with any particular system depends upon experience and the individual care and attention to detail.

One of the first essentials is cleanliness, and every care should be taken to see that the brooder-house and brooders are thoroughly cleaned and disinfected. Where the brooder-house has been used during the year for the housing of adult birds, extra care should be taken to guard against disease germs. Caustic soda and boiling water are the best for this purpose, and the floor and walls should receive a good soaking. Outbreaks of coccidiosis and other troubles have been traced to a neglect of this very important matter.

Another important matter is to guard against dampness, especially where a large number of chickens are brooded together under a canopy brooder. One of the best ways of protecting the chickens against dampness is to use a wire-netting frame as described on page 71 of this Department's Bulletin No. 66, "Utility Poultry-keeping," copies of which may be had from the Publisher, Department of Agriculture, Wellington, C 1, price 1s., postage free.

Plenty of clean, dry bedding should be used. Straw chaff is the best material for this purpose. After the chickens are three weeks old it pays to put a little fresh chaff under the brooder each night for the chickens to sleep on, but never put clean litter on top of damp or dirty material. Damp litter is often the cause of brooder pneumonia. No ground draughts should disturb the chickens at night, as this will cause them to crowd. A close watch should be kept on the chickens just as they are settling down for the night, and if they are inclined to crowd they should be gently spread out. Generally, chickens will start to crowd into heaps under the brooder after a week or ten days. However, if care is taken to prevent this by being in attendance just at camping-time much trouble will be avoided. This, in the writer's opinion, is one of the secrets of rearing a large number of chickens under one brooder. If allowed to camp in large heaps they do not thrive.

Feeding of Chickens.

There are many methods of feeding chickens, and most successful poultry-keepers have their own system. The following method was adopted by Mr. H. Kitto, Poultry Instructor, while he was Overseer of the Wallaceville Poultry Station, and has been used with success for some years

The chickens are transferred from the incubators to the brooders at night-time. On the following morning, usually about forty-eight hours after hatching, they are given their first meal. This consists of a grain mixture which is fed during the first seven days, and is made up as follows: 75 lb. finely-cracked wheat and 25 lb. finely-cracked maize. This mixture is apportioned out daily in quantities according to the number of chickens to be fed, and how they are eating.

Three meals per day are given, the first at 7.30 a m., the second at 11.30 a.m., and the evening meal at 4 30 p.m. The quantity of the mixture which is intended to be given is first prepared by being soaked in hot water for about an hour before feeding-time. The grains are allowed to absorb sufficient moisture to cause them to swell. Finely-cracked oyster-shell grit is placed in open hoppers or boxes, to which the chickens have free access at all times.

Supply of Water.—At the same time as the first meal is given the chickens are provided with water to drink. When the chickens are four days old fresh skim-milk is given them to drink. While milk is being thus supplied,

water is not provided, milk being given alone as a drink until the chickens are old enough to go away from the heat. This, generally speaking, is when they are from six to eight weeks old, according to weather conditions.

After the chickens have been transferred from the brooders to the colony-houses, water is kept within easy reach always, but so long as an ample supply of milk is available it still is used.

Green Food.—On the fourth day green food—silver beet and young green oats, finely-cut up—is fed along with the other rations. When the chickens are seen to be consuming the green food, a regular supply is provided and is fed separately, between meal-hours, at 9 a.m., 2 p.m., and again after the last meal at 5 p.m.

Mash.—Commencing on the eighth day after hatching, the chickens are given two mash meals and one meal of grain per day. The grain-mixture remains the same as during the first week, but the grains used are a little larger each week, according to the development of the birds. The mash consists of two parts of wheat-meal to three parts of bran. This is moistened with sour milk, and every care is taken when mixing to produce it in as crumbly a condition as possible and not too pasty or too moist.

There is then no material change made in the diet until the age of eight weeks is reached. At this stage, and provided the chickens have done well, they should be big enough to be given whole grains with the exception of maize, which is a little too large.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Preparations for the New Season.

DURING the dormant season every spare moment should be spent in making preparations for the next season's work. All defective supers, roofs, and bottom-boards should be overhauled, and, where necessary, given a good coat of paint. This work, if delayed, is apt to interfere with the main work in the apiary when the bees are calling for special attention, and should not be postponed.

If it is desired to increase the apiary, hive and frame making should be pushed on and ample provision made for increase before the actual time arrives for putting plans into operation. Where the beekeeper does not make his own hives he should now order sufficient stocks to see him through the season. In the majority of cases it does not pay him to make his own appliances. Hive-manufacturing in the Dominion has been brought to a high standard, and unless the apiarist has ample capital to purchase machinery to turn out good hives he will find the home-made article too costly in the long-run. Whether the beekeeper is working on a small or large scale, he should aim at uniformity, and in building up an apiary decide at the beginning on the style of hive and frame he is going to use, and continue on those lines. Non-fitting supers and frames mean extra labour, and lead to endless trouble. The sizes in use are mostly ten and twelve-frame, and experience of his district enables the beekeeper to decide as to the best one to adopt

To meet those cases where cost is a consideration, a durable frame-hive which complies with the provisions of the Apiaries Act can be made out of a petrol-case. Petrol-cases are obtainable for a few pence, and can be converted readily by any one handy with tools. A kerosene-case may also be used, but it will be found necessary to reinforce it, so that the petrol case is the handier. Particulars of a cheap home-made hive are given in the Department's Bulletin No. 128, " Bee-keeping."

Overhauling the Hives.

As advised last month, all supers should be removed and the bees confined to the brood-chamber. This keeps the bees snug and promotes brood-rearing, and at the same time facilitates the work of giving the hives their first spring overhaul. During the course of the winter there is usually an accumulation of pollen, dead bees, &c., on the bottom-boards, and consequently the latter require cleansing. All operations at this period should be carried out quickly as a safeguard against robbing. To cleanse the bottom-board a spare one should be brought into use. Set the hive temporarily on the spare board while scraping and cleansing the permanent one, then replace the hive on its permanent stand. See that the hives have a slight cant towards the entrance. This prevents moisture settling on the bottom-board, which is apt to cause the death of a considerable number of bees and besides it makes the hive damp and unwholesome.

Spring Work.

During August, whenever the temperature allows, the colonies may be given their first examination. It is highly important that this work be not postponed until brood-rearing has started in earnest, more especially in cases where ample stores were not left to carry the bees over early stages of this important function. Delay in making an examination may lead to spring losses, and nothing is more annoying than to find colonies dead through neglect to provide sufficient stores. Usually a colony's requirements are attended to in the late autumn, when the apiarist endeavours to gauge the amount of food requisite to carry the bees through the winter and spring periods. It may happen, however, that mild weather is experienced, when the drain on the stores to feed the young bees, if not supplemented, reduces a colony to starvation. Nothing should be left to chance during the critical months of spring, and no effort spared to see that each individual colony has sufficient food to meet current demands. Colonies which contain 15 lb. to 20 lb. of honey may be left until a later examination. If the hives contain less, they should be watched closely and preparation made for feeding. Bulletin No. 128, on page 27, contains information about the spring feeding of bees.

Queen-right Colonies.

The most important factor in a colony's condition is its queen. Advantage should be taken of the first examination to see that the queen is suitable in all respects. If a colony is in normal condition as regards strength and stores there should be fair-sized patches of brood in the centre frames, but this is not sufficient to determine that the colony is queen-right. The cells adjacent to the brood should be quickly examined for eggs, which are the only indication that the queen is present. If neither brood nor eggs are found, then the question of the colony being queenless should be shelved until about ten days later. At each examination make a note of each hive and its condition for future reference.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Raising Seedling Plants under Glass.

During the summer, when the temperature of air and water approaches the optimum for raising seedlings under glass or outside, this operation is successfully carried out with much less attention than is necessary for the important operation of raising seedling plants in boxes under glass during the month of August for planting out about two months later. Sharp frosts and bursts of sunshine frequently occur then and make it difficult to maintain a steady soil and air temperature of about 60° F., or whatever may be the most suitable for the particular seeds being grown. It is only by

close attention, then, to the heating-system, water-temperature, and ventilation that good work may be done. Some growers are inclined to force the growth of the plants by means of high temperatures and humidity. The plants often look very fine until it comes to hardening them off before planting outside; then difficulties arise which have the effect of making establishment in the new quarters very slow, and of bringing about a considerable loss from disease, and a crop much below the average. Disease levies a heavy toll of plants when the soil is composed of poor materials inadequately prepared. Fresh rotted turf, stacked for twelve months or more; thoroughly decayed manure which has been stored under cover, and turned occasionally; with sharp sand mixed together in suitable proportions make a compost in which most of these seedlings may be raised with little trouble with proper attention to heat, water, and ventilation.

In the large-scale production of the present day it is customary to assist in guarding against loss from disease by sterilizing the compost before sowing the seeds; and many smaller growers, who perhaps in an emergency have to use a compost insufficiently prepared, often would be well advised to take the same precaution. Useful information on this subject is contained in the article on the control of damping-off by soil treatment by Brien and Chamberlain in the May number of this *Journal*. For the control of the fungi causing loss in this way steam-heating disinfection of the soil or treatment with formalin 1·25 per cent. is recommended. And what controls damping-off diseases in the soil controls many others—especially will steam-heating the soil do so.

Sterilizing by means of steam heat is commonly done by placing the soil in a shallow bin on a perforated false bottom beneath which steam is liberated. An oil-drum is sometimes used for the purpose The head is cut out, perforated, and then used as a false bottom supported on a few bricks. In the side of the drum, beneath the false bottom, a pipe is fixed to which a steam-pipe is screwed and steam turned on until a temperature of 180° to 200° F. is obtained and held for twenty minutes, which is sufficiently long to control most of troubles under consideration. In some instances the space beneath the false bottom is enlarged, filled with water, which is boiled by means of a fire placed beneath it Heating the soil by steam produced in this way is somewhat slower, but quite effective

Besides destroying fungous spores, insects, weed-seeds, &c, the high temperature has considerable effect on the chemical and physical condition of the soil, particularly that part of it which is known as humus These interactions have been the subject of considerable study by W. J. C. Lawrence and J. Newell, of the John Innes Horticultural Institution at Merton, where seedling-plants of many kinds are raised in large quantities in sterilized soil. As a result of their investigations they have evolved a composting technique which, they find, gives far better results that the old method, especially in the early stages of germination and seedling-growth. For seed-sowing and pricking off a mixture of loam, moss-peat, and sand is used, adding 1½ oz. superphosphate and 1 oz. pure chalk to each bushel of compost. The moss-peat is used instead of leaf-soil owing to its uniform quality and freedom from insects, fungous diseases, and weed-seeds, but additional drainage is necessary when it is used to replace leaf-soil. The loam and sand are sterilized separately, and the unsterilized moss-peat and fertilizers are added afterwards. The compost is then stored for six weeks and drawn from as required.

Lime mixed in the compost before sterilizing was found to be detrimental owing to its interaction with moss-peat when subject to heating by steam. As a result it was decided that no lime in any form should be added to soils before sterilizing.

It was this result which led to a general investigation of the behaviour, after sterilization, of the various ingredients used in composting. The greatest check to growth was obtained when loam, moss-peat, and sand were all sterilized together. The best plants were obtained where all the

ingredients were sterilized separately. These results are not confined to composts to which moss-peat is a part, as similar results are obtained when leaf-soil replaces moss-peat.

From the beginning of the experiments it had seemed clear that the marked increase of nitrogen which occurs in sterilized soil needed balancing by the addition of a suitable fertilizer. A series of experiments led to the adoption of the addition of superphosphate. As there was no advantage found in mixing it in before sterilizing, but, on the contrary, some plants made better growth when the phosphate was added afterwards, that course is generally recommended. Experiments carried out indicate that the sterilization of the soils changed the phosphatic requirement of the compost, and that that ingredient is a necessary complement of sterilized soil.

It is common experience among users of sterilized soil that the check to seedling-growth is most severe immediately after sterilizing, but that, on storing, the soil gradually recovers and can be used with safety after a month or two. The time needed for recuperation was known only vaguely, and tests were arranged to determine it more accurately. The standard seed-compost, including superphosphate, before described, was sown as soon as possible after sterilization, and further sowings were made at intervals of two days. Similar composts which had been prepared for some weeks were used as controls. In no case could any difference be detected in the rate of germination. These standard composts differ from ordinary fresh sterilized soil in only one important respect—viz., they contain added superphosphate and chalk. From these results it is clear that the addition of superphosphate almost immediately corrects the check to growth commonly associated with newly-sterilized soils.

These precautions, in order of their importance, are: (1) Lime must not be added to a soil before sterilizing; (2) the addition of phosphate is necessary to balance the changed soil conditions brought about by sterilizing, (3) composting should be done after, and not before, sterilizing; (4) fertilizers should be added after sterilizing. These are radical modifications to the usual present practice which might well receive the attention of growers here, especially those who are not getting the best results from their present methods.

Vegetable Crops.

Outdoors, in land that has been well prepared, sow during the month of August white turnips, globe-beet, early carrots, radishes, peas, onions, parsnips, parsley, lettuce, summer cabbage, and cauliflower; and plant out autumn-sown onions, artichokes, early potatoes, and asparagus

On a hot-bed under glass sow tomatoes, chilis, peppers, celery, marrows, melons, and cucumbers, for planting out towards the end of October, or thereabouts. Steady growth, obtained chiefly by means of ample ventilation whenever weather permits, produces well-rooted sturdy plants which, when planted out, grow without a check and produce the best crops Celery should be sown thinly: it is usually sown much too thickly. These crops usually suffer most from lack of attention to ventilation, which requires constant supervision during the changeable weather experienced at this season. Use water only when it is really necessary, and see that it is tepid.

A deep, light, rich, moist, well-drained soil in an open position, but sheltered from prevailing winds, is suited for the asparagus crop, which is best planted out now. Sturdy one-year-old plants from which all undersized specimens have been removed should be used. Plants should be from a good strain of seed of a proved variety.

Spacing and depth are important when planting asparagus. Commercial crops are best planted 5 ft. to 6 ft. between the rows and 18 in. between the plants. In the home garden they may be planted in a double row alternately, 18 in. between rows and plants. If more is required there should be a space of 4 ft. between the one double row and the next. Where white asparagus is required for canning, the soil is ridged up over the crowns, and to enable this to be done there must be a space of 7 ft. to 8 ft. between the rows. In

suitable land the crowns are planted 8 in. deep, covering them to a depth of 2 in. only at the time of planting, and allowing the trenches to be gradually filled later when hoeing. On drier land 10 in. is not too deep, and on rather heavy land 5 in. is sufficient. As with other plants, the roots must not be exposed to a dry atmosphere while being transplanted.

Towards the end of the month of August last season's parsnip crop will commence to grow, and the flavour of the roots will deteriorate. Before this happens they should be lifted and stored in a cool place.

Where tomatoes are to be planted out under glass the boxes of plants should be placed in the house to acclimatize for at least a few days before setting them out—for which operation they should be in a fairly moist condition.

Small and Sundry Fruits.

The successful grower has an intimate acquaintance with most of the insects and fungi which have taken up their abode in his crops, or that may possibly do so. The least symptom is noted, and, where necessary, steps are taken to meet the case. Where heavy cropping is done especially, this knowledge and action are indispensable if such cropping is to be maintained The greatest measure of control is obtained by the application of preventive sprays made in early spring.

On established passion-vines laterals which have borne fruit should now be trimmed back to base buds, and the vines given a thorough application of Bordeaux 4–5–50 to prevent the spread of brown spot and scab disease. Only when seasonal pruning is done can this application be made effectively It should be repeated at intervals of about one month as may be necessary Infected untrained vines should be destroyed.

Where cane-blight and leaf-spot are attacking raspberries or loganberries, Bordeaux 4–5–50 should be applied just before growth commences For the control of leaf-spot on currants and gooseberries the Bordeaux spray should be applied at the same stage of growth and repeated as may be necessary Strawberry leaf-spot is very common, and, where present, Bordeaux 4–5–50 should be applied now and repeated at intervals of three or four weeks so long as it may be necessary

Where caterpillars or chewing insects are also present ¾ lb. arsenate of lead powder should be added to each 50 gallons of spray Where arsenate of lead paste is used 1½ lb. of that ingredient will be required. Materials required to make 4 gallons Bordeaux 4–5–50 strength are : 5 oz bluestone, 6¼ oz. lime, and 4 gallons water. If arsenate of lead is used 1 oz. powder or 2 oz. of paste should be added.

The Homestead Garden.

New wood on roses is sometimes killed during the spring by hard frosts, and when this occurs after pruning the results are serious. For that reason growers in cold localities sometimes defer pruning until the early part of September, when, in spite of any new terminal growth which may have been frosted, there will still be on the bushes plenty of dormant buds to which one may cut back and produce new growth during a safe period. Elsewhere rose-pruning should now be completed with other deciduous hardwood plants, followed by the pruning of such evergreen shrubs as require that attention either for the purpose of restricting growth or to encourage flowering. Special attention should be given to climbers on dwelling, walls, trellis, or pergola where uncontrolled growth interferes with painting and repairs and causes dampness and dirt to accumulate. *Wisteria, Bignonia, Bougainvillea, Actinidia,* vines and roses, with a little consideration, can be pruned and trained in a way which permits easy removal for painting and at the same time provides even a better display of blossom. Superfluous strong-wood shoots should be cut out entirely and only what is required to cover the trellis trained in.

Sow hardy annuals outside and half-hardy annuals in boxes on a hot-bed where a temperature of about 60° F. can be provided. Complete the planting of hard-wood and herbaceous perennial plants.

—*W. C. Hyde, Horticulturist, Wellington.*

WEATHER RECORDS: JUNE, 1936.

Dominion Meteorological Office.

NOTES FOR JUNE.

OWING especially to the absence of wind or severe southerly weather, June was a very mild month for winter. Frosts and the lack of rain caused the growth of pasture to be checked over much of the North Island, but elsewhere there was an unusual amount, and the quality is better than usual at this time of year. Stock are generally in excellent condition, but hoggets still rather backward in many places. In some places spring flowers are already showing. Farm-work is well advanced.

Rainfall.—Heavy rains in Hawke's Bay on the 16th, in Nelson on the 27th and 28th, and in parts of South Canterbury on the 15th and 29th were responsible for those districts having more than the average rainfall. The remainder of the country, however, had a very dry month. Less than half the average was recorded at many places, and in some it was the driest June on record.

Temperatures.—In Taranaki temperatures were slightly above normal, but in the remainder of the North Island, owing to the prevalence of south-westerly winds, they were considerably below. In the Waikato and the Bay of Plenty the departures were generally in the neighbourhood of 3° F. The west coast of the South Island and South Canterbury also had rather low temperatures. In the interior, however, means were as much as 3° F. and more above normal. In the fine, still weather of the first week there were many hard frosts, especially in the Bay of Plenty and Waikato districts. There is less snow than usual on the mountains.

Sunshine.—The duration of bright sunshine was above the average for June in most places, but Nelson, Hanmer Springs, and South Canterbury had less than the usual. Tauranga recorded 170·6 hours and Napier 167·8.

Storm Systems.—The month began with very high pressures ruling over the Dominion. Fine weather prevailed, with little wind. These conditions continued for a week, but on the 8th pressure began to fall, and on the 9th two depressions followed each other closely over the Dominion. General, though for the most part light to moderate, rain was experienced. Another anticyclone and several more fine days followed.

On the 15th a series of depressions commenced to traverse the country, the most important being one of cyclonic form, which passed on the 16th. General rains were experienced on the 15th and 16th, some large totals being recorded over much of the North Island. Rivers rose high, and some flooding was caused in the Bay of Plenty, Poverty Bay, Hawke's Bay, Wairarapa, and Manawatu districts. On the 18th strong south-westerly winds and cold temperatures set in, some snow falling on the ranges. Rather unsettled conditions still persisted for some days, but there was a gradual improvement and fine weather ruled from the 24th to the 26th.

On the 27th there began the passage of another set of complicated depressions, and, commencing in the western districts of the South Island, unsettled weather with general rain persisted from then onwards to the end of the month. During the 28th and the following night, a cyclone crossed the central portion of the Dominion. Gale winds were associated with it, and there was heavy precipitation in the Central Provinces and South Canterbury, with snow on the mountains. Some flooding occurred at Nelson.

The storm systems of the month were of unusual type, and the situation was seldom simple while depressions were passing. At this time of year one expects a rather regular eastward progression of alternate high- and low pressure areas, but during June these conditions failed to materialize.

RAINFALLS FOR JUNE, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
North Island.						
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	3·75	17	1·20	6·59	28·02	28·16
Russell	3·12	13	0·80	6·49	57·27	27·33
Whangarei	2·20	20	0·42	6·54	36·86	31·60
Auckland	2·75	16	0·40	5·44	25·37	24·28
Hamilton	1·75	12	0·40	5·11	27·49	23·90
Rotorua	3·93	10	0·76	5·25	36·44	26·87
Kawhia	1·73	7	0·61	5·72	26·50	25·54
New Plymouth	3·26	16	0·79	5·95	28·26	28·54
Riversdale, Inglewood	5·36	16	1·25	10·27	45·73	48·65
Whangamomona	2·07	5	0·58	7·89	34·74	35·70
Hawera	2·45	13	0·48	4·41	22·62	21·39
Tairua	2·23	10	0·69	6·07	30·85	33·56
Tauranga	3·17	9	1·36	5·35	33·28	26·88
Maraehako Station, Opotiki	2·12	10	0·36	5·66	33·39	27·79
Gisborne	2·15	14	0·90	4·90	28·47	24·91
Taupo	2·66	10	0·78	4·56	26·29	21·36
Napier	5·85	11	4·49	2·92	33·59	16·08
Hastings	4·70	6	4·05	3·07	30·18	16·63
Whakarara Station	3·75	6	0·95	..	35·68	..
Taihape	3·14	15	1·03	3·38	25·95	17·81
Masterton	2·84	9	1·45	3·59	28·02	18·77
Patea	2·67	12	0·52	4·24	24·63	21·40
Wanganui	2·03	10	0·88	3·37	22·28	17·70
Foxton	1·73	8	0·74	3·39	20·65	15·27
Wellington	3·33	13	0·72	4·31	27·41	20·89
South Island.						
Westport	6·39	13	1·47	8·85	31·30	46·50
Greymouth	5·32	15	1·86	8·80	35·25	49·56
Hokitika	8·13	15	3·74	9·22	37·59	55·09
Ross	6·84	10	3·29	8·73	42·59	62·77
Arthurs Pass	..	..	..	10·53	..	75·94
Okuru, South Westland	9·59	11	2·75	10·72	63·67	72·04
Collingwood	8·22	10	2·81	10·30	39·77	45·08
Nelson	3·97	7	1·91	3·51	16·28	18·32
Spring Creek, Blenheim	2·41	8	1·45	2·94	17·50	14·47
Seddon	1·50	9	0·85	2·09	14·72	12·32
Hanmer Springs	1·57	8	0·59	3·39	29·34	21·77
Highfield, Waiau	1·66	6	0·55	2·47	23·29	16·74
Gore Bay	1·58	8	0·47	2·69	20·89	15·87
Christchurch	0·82	12	0·45	2·53	19·30	12·63
Timaru	2·29	5	1·08	1·75	18·07	11·14
Lambrook Station, Fairlie	2·05	7	1·39	1·86	15·38	11·98
Benmore Station, Clearburn	1·00	7	0·68	1·81	8·50	12·80
Oamaru	0·96	8	0·63	1·98	15·06	10·98
Queenstown	0·48	10	0·11	2·22	15·02	15·35
Clyde	0·84	4	0·46	0·92	6·67	7·76
Dunedin	1·21	14	0·35	3·14	21·19	18·08
Wendon	0·80	12	0·25	2·59	14·76	15·48
Balclutha	1·44	13	0·50	1·99	13·84	12·71
Invercargill	2·76	18	0·55	3·64	21·15	23·31
Puysegur Point	4·81	20	0·74	6·59	39·48	42·26
Half-moon Bay	3·99	16	0·77	4·91	21·38	29·13

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CONTROL OF RAGWORT WITH "ATLACIDE" AS COMPARED WITH SODIUM CHLORATE.

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THE advocacy of sodium chlorate as a weed-killer, particularly in the control by spraying of ragwort (*Senecio jacobaea*), has necessitated much emphasis being placed on its dangerous properties when in the hands of a careless individual. While there is not much fear of accident provided reasonable precautions are taken, such as the thorough rinsing of clothes saturated with the material, the occurrence of accidents, some with fatal consequences, has intensified the search for a substitute equally effective in regard to weed-control and free from the attendant risks. Aston(1) describes experiments with thio-cyanates in controlling ragwort, and mentions that these materials are not combustible or explosive when in contact with organic materials. In discussing substitutes for sodium chlorate Deem(2) mentions "Atlacide" as having been thoroughly tested to show an efficiency slightly less than that of sodium chlorate, but to have the advantage of little or no risk through fire or explosion.

Representations made by the agents of "Atlacide" to have the product included in the Government subsidy granted to importers of sodium chlorate necessitated further trials being carried out to compare both these substances when used on ragwort. One series of trials was conducted in the King-country, South Taranaki, and in Southland during 1935, while a second series of experiments, on a larger scale, was conducted in the Auckland Province during 1936.

PROPERTIES OF "ATLACIDE."

"Atlacide" is a proprietary material containing sodium chlorate, calcium chloride, and other chemicals.

A report from the U.S. Bureau of Explosives states that "Atlacide" is inherently safer than sodium chlorate on account of the inert matter tending to nullify the explosive properties of sodium chlorate and its hygroscopic tendencies. A significant characteristic of "Atlacide" is its great apparent resistance to ignition by friction or impact. Actual trials carried out by independent chemists have indicated this resistance to obtain under field conditions.

The material is in the form of a fine powder, and in this condition it is specially suited for direct application as a dust.

EXPERIMENTS WITH "ATLACIDE," 1935 SEASON.

Experiments on ragwort were laid down in the autumn of 1935 on five farms. The treatments included applications of 1 per cent., 3 per cent., and 5 per cent. solution of "Atlacide" and sodium chlorate respectively, and also these materials applied in the dry state mixed with carbonate of lime in two different proportions—viz., 2 parts specific to 98 parts lime and 5 parts specific to 95 parts lime. The actual quantities of solution or dust applied were kept constant as far as possible.

In each experiment plots of $\frac{1}{80}$ acre were taken on which ragwort was growing fairly thickly, and the number of plants on each plot was ascertained before treatment. Counts were taken about three weeks after treatment and again about ten weeks after treatment, although the second observation was generally difficult in view of seedling plants which had made their appearance after the dying-down of the older plants. Inconsistencies between the numbers of these seedlings on plots treated with various strengths of the same specific suggest that small differences in the number of seedlings may be entirely fortuitous, particularly as the materials were applied to large plants, and their effect on seedling-growth has not therefore been considered. The effect on the weeds which were actually sprayed is shown in Table I.

Table I.—Effect on Ragwort of "Atlacide" (Old Formula) and Sodium Chlorate respectively in Experiments, 1935 Season

Specific.	Strength of Solution or Mix.	Percentage Kill in various Trials (Name of Co-operating Farmer given in each case).				
		E. V. Allison, Te Kuiti.	F. Schnelle, Te Kuiti.	A. Bettridge, Tawhiti.	R. Russell, Waianiwa	A. Scott, Tisbury.
Sodium chl ..	1 per cent ..	83	99·5	100	100	No spray treatments
Atlacide ..	1 per cent ..	65	99	100	100	
Sodium chl ..	3 per cent ..	99	100	100	100	
Atlacide ..	3 per cent. ..	88	100	100	99	
Sodium chl ..	5 per cent ..	99	100	100	100	
Atlacide ..	5 per cent. ..	96	100	100	100	
Sodium chl ..	2 to 98 lime ..	90	100	100	No dust treatments	98·6
Atlacide ..	2 to 98 lime ..	61	99	100		97·5
Sodium chl. ..	5 to 95 lime ..	92	100	100		99·4
Atlacide ..	5 to 95 lime ..	92	100	100		99·1

In four of the trials "Atlacide" and sodium chlorate were about equal in their effect, the trend being slightly in favour of sodium chlorate. The trial shown in the third column had a fair growth of grass and clovers when treated, and possibly many young plants were missed when sprayed or dusted, although this would tend to affect the results from sodium chlorate and "Atlacide" equally.

EXPERIMENTS WITH "ATLACIDE," 1936 SEASON.

As the manufacturers of "Atlacide" intended adopting a new and improved formula for their material, it was decided to carry out further trials, and nine experiments in which the new material was used were laid down in the autumn of 1936. In most of these trials treatments

were confined to 3-per-cent. and 5-per-cent. solutions, and dry applications consisting of 5 parts of specific to 95 parts carbonate of lime. These mixtures were more in accord with the usual strengths recommended for ragwort-destruction—viz., 3 per cent. to 6 per cent., according to the nature of growth. The same quantities of spray or dust were applied to each plot, and the areas treated ranged from small plots of $\frac{1}{80}$ acre to large blocks of several acres. On the latter, small representative areas were marked off on which the plants were counted before and after treatment. The second counts were taken from three weeks to two months after treatment with the following results :—

Table II.—Effect on Ragwort of " Atlacide " (New Formula) and Sodium Chlorate in Experiments, 1936 Season.

Trial.	Percentage of Sprayed Plants killed.					
	3% Solution.		5% Solution.		Lime, 95%; Specific, 5%.	
	Atlacide.	Sod. Chl.	Atlacide.	Sod. Chl.	Atlacide.	Sod. Chl.
1 Crown lands, Kopaki ..	91·5	96·0	93	96	78	87
2. Crown lands, Kopaki* ..	93·4	99·1	97	99·6	60·3	88·6
3 State Forest, Rotorua ..	92·5	97·7	99·5	95·9	94·2	94·2
4 State Farm, Mamaku .	100	..	100	100	100	100
5 State Farm, Mamaku ..	89	..	87·8	93·3	..	..
6 A. K. McNaughton, Te Awamutu	..	..	..	..	100	100
7 A. K McNaughton, Te Awamutu	Trials covered by flood prevented counts being taken. From observations made the merits of " Atlacide " and sodium chlorate were considered equal					
8. Native lands, Te Awamutu						

* Seedling plants appeared in large numbers after the killing of the older plants in this trial, and a second application of spray or dust was given on 12th May, 1936. Later counts revealed 100 per cent. kill on the sodium-chlorate plots and 99 per cent. kill on those treated with " Atlacide."

Considering the data collectively from experiments with the new formula " Atlacide," the later appears to be about 97 per cent. as effective as sodium chlorate in the 3 per cent. solution, about 99 per cent. as effective in the 5 per cent. solution, and about 93 per cent. as effective when applied in the dry form with lime.

THE PLACE OF " ATLACIDE " IN FARMING PRACTICE.

No mention of relative costs has been made, as it is understood that " Atlacide," which is now to receive the advantage of the Government subsidy, will be sold at a price competitive with that of sodium chlorate. The comparative safety of " Atlacide " will be a strong point in its favour with some farmers, although, on the other hand, it must be emphasized that reasonable precautions taken when using sodium chlorate almost remove the dangers associated with this material. Government institutions, local bodies, and others employing large numbers of casual labourers in the destruction of weeds, however, may be more apprehensive of the risks, and their responsibility in this connection will be lessened by using " Atlacide." As indicated by the experiments described above, this material has an efficiency almost equal to that of sodium chlorate.

ACKNOWLEDGMENTS.

The field work in connection with these trials was carried out by Instructors K. M Montgomery, C. Haynes, and A. Stuart, of the Fields Division, in 1935, and by Messrs. Melrose, Newson, Bonner, and McMillan, of the Live-stock Division, and also Mr. K. M. Montgomery, of the Fields Division, in 1936. The assistance of those farmers who co-operated in the trials is cordially acknowledged. Supplies of "Atlacide" were made available by Messrs. B. K. Morton Proprietary, Ltd.

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APPLICATION OF ORCHARD-SPRAYS.

III. SPRAY NOZZLES.

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DURING the development of commercial spraying various types of nozzles have been evolved with the object of dispersing a small amount of spray liquid over a wide area. Dispersion was effected in the earliest types of nozzles by forcing a jet of liquid against an obstruction such as wire gauze or a metal flange. The most successful nozzle of this type was the "Bordeaux" (Fig. 1), first patented in America in 1878. This nozzle has persisted practically

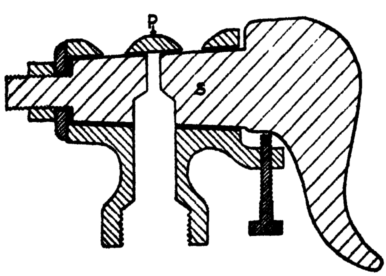


FIG. 1. BORDEAUX NOZZLE.
Stop-cock, S; projecting flange, P.

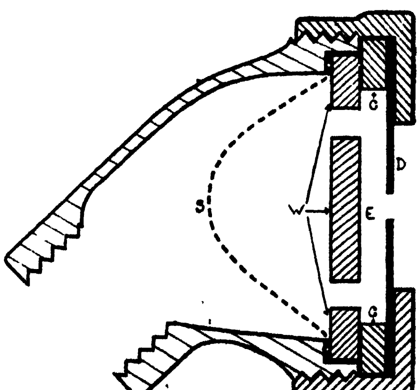


FIG. 2. CYCLONE NOZZLE.
Strainer, S; whorl-plate, W; whorl-chamber, E; rubber gasket, G; disk, D.

unchanged to the present day, but, owing to the coarse spray produced and the difficulty of maintaining correct adjustment, is rarely used in commercial orchards. The principle of imparting a whirling motion to the spray liquid before it left the nozzle was

discovered by W. S. Barnard in 1880 (Riley, 1885). Nozzles built on this principle were termed "cyclone" nozzles, and in modified forms have been used ever since.

The main features of modern cyclone nozzles are the strainer, whorl-plate, whorl-chamber, and disk (Fig. 2). In passing through oblique openings in the whorl-plate, the spray liquid is given a rotary motion in the whorl-chamber, and on being forced through a circular opening in the centre of the disk is broken into a hollow cone of spray droplets.

For efficient application a wide-angle cone of fine droplets of spray is required with sufficient penetration to reach all parts of the tree. At the same time a sufficiently high rate of delivery is required to enable complete coverage to be obtained in minimum time and without undue wastage. Different workers have shown that the distribution of spray is dependent on nozzle pressure and on the construction of the various nozzle parts. The relationship between the factors involved is summarized in Table I.

Table I.—Summary of Factors recorded as influencing Spray-distribution.

Increase in	Effects on			Volume Delivery.
	Angle of Cone.	Fineness of Droplets.	Depth of Penetration.	
Pressure . .	Increased (b) .	Increased (a), (b), (c)	Increased (a), (c) ..	Increased (a), (b), (c), (e).
Diameter of disk aperture	Increased (a), (b)	Not affected (a)	Increased (a) ..	Increased (a), (b), (c).
Thickness of disk	Decreased (a), (b)	Decreased (a), (b)		Decreased (b).
Depth of whorl-chamber	Decreased (a), (b) (c)	Decreased (a), (b), (c)	Increased (a), (c) .	Increased (a), (b) (c).
Diameter of whorl-plate openings	Decreased (a) .	Decreased (a)	Increased (a)	Increased (a).
* Angle of whorl-plate openings	Increased (b) .	Increased (b) ..	.	..
Number of whorl-plate openings	.	..	Increased (d)	

(a) Davies and Smyth-Homewood, 1934.
(b) Anderson and Roth, 1923
(c) Wright and Woodman, 1932.
(d) Hough, 1928.
(e) Cardinell and Gaston, 1932
* The angle of the whorl plate openings refers to the degree to which they diverge from a right angle to the surface of the disk.

Experiments have been conducted since 1933 with the object of determining the relative significance of nozzle pressure and of the different nozzle parts in their effects on (a) the angle of the spray cone and the distribution and fineness of spray droplets, (b) the depth of penetration—i.e., distance to which spray is driven, and (c) on volume delivery—i.e., volume of spray delivered in unit time.

Angle of Spray Cone and Distribution and Fineness of Spray Droplets.

Experimental Method.

Apparatus was designed, similar to that described by Anderson and Roth (1923, p. 153), in which sheets of white paper were exposed to the spray for short lengths of time. The spray droplets formed stippled deposits on the paper in the form of circular bands where the cones

were "hollow" or as infilled circular areas where the cones were "solid." From the spray patterns thus produced the angles of spray cones were measured and the fineness and distribution of spray droplets compared.

Clearly defined patterns were obtained by using a spray mixture consisting of copper-polysulphides prepared by mixing lime-sulphur and copper-sulphate. This proved cheaper to use than soluble dyes, and had the advantage that, although the water from each droplet soaked into the paper, the area covered by copper-polysulphide did not extend, since the latter was not absorbed. The length of exposure was varied as far as possible to prevent the droplets of spray massing together.

An electrically driven power pump was used, adjustments in pressure being made at the pump, and the working-pressure measured by a tested gauge placed a few inches behind the nozzle. The nozzles were held on a rigid frame, provision being made for varying the distances from the sheets of paper.

A cyclone nozzle similar to that shown in Fig. 2 was employed as a standard, with variations in the construction of certain parts. All the whorl-plates used were $1\frac{1}{8}$ in. in diameter and $\frac{1}{8}$ in. thick, but varied in the number, angle, and diameter of the openings. The whorl-chamber was 1 in. in diameter and the normal depth 0·12 in., variations in depth being obtained, where required, by the use of rubber gaskets of different thicknesses. Alterations in the shape of the whorl-chamber were made by means of $\frac{1}{4}$-in. diameter pins projecting from the centre of certain whorl-plates. Disks were $1\frac{1}{4}$ in. in diameter, but varied in thickness and in the diameter of apertures. Unless otherwise stated a disk thickness of approximately $\frac{2}{64}$ in. has been used.

The diameter of each spray pattern was measured as the diameter of a circle passing through the portion of the band of spray in which deposition was heaviest (Fig. 9). Repeated measurements by this method showed that the maximum error was approximately $\frac{1}{2}$ in. Where patterns were uneven the average of several measurements was taken. The relative fineness of spray droplets and their distribution in the spray cone were estimated by comparison of patterns.

RESULTS.

(i) *Pressure.*—The angle of the spray cone increased with increase in pressure up to approximately 100 lb. With further increase up to 300 lb. the angle of the cone, after remaining constant over a short range of pressures varying with the nozzle used, tended to diminish (Fig. 3).

At low pressures the cone was infilled and consisted of coarse droplets of spray. As pressures were increased up to 200 lb. to 250 lb. the band of spray became narrower, the cone progressively more hollow, and droplets of spray finer. With further increase up to 300 lb. the band of spray widened slightly, the droplets of spray became finer, and the centre of the cone partially infilled (Figs. 4, 5, and 6).

(ii) *Disc Aperture.*—With increase in the diameter of disk apertures over a range of $\frac{3}{64}$ in., $\frac{4}{64}$ in., $\frac{5}{64}$ in., $\frac{6}{64}$ in., $\frac{7}{64}$ in., and $\frac{8}{64}$ in., the angle of the spray cone increased. The rate at which the angle of the cone

increased with increasing disc size was influenced by the structure of the whorl-plate, becoming greater as the number or diameter of openings in the whorl-plate decreased or the angle of the openings increased.

As the diameter of the disk aperture was increased, the cone became more hollow and the band of spray wider (Figs. 8, 9, and 10) At the same time the size of spray droplets increased. The later effect was most marked where nozzle pressures were low, and tended to disappear at higher pressures and where the number and diameter of the whorl-plate openings was increased or the angle decreased.

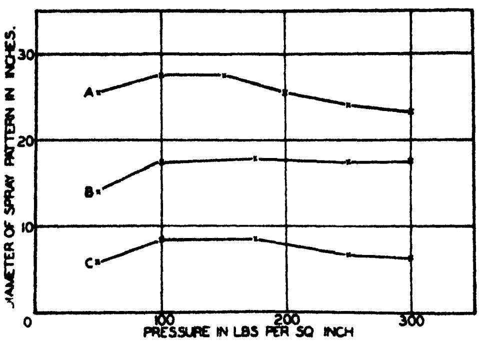


FIG. 3 EFFECT OF INCREASE IN PRESSURE ON THE DIAMETER OF SPRAY PATTERNS PRODUCED 2 FT FROM THE NOZZLE

The different curves show the effects produced when using whorl-plates and disks of various construction, as follows.—

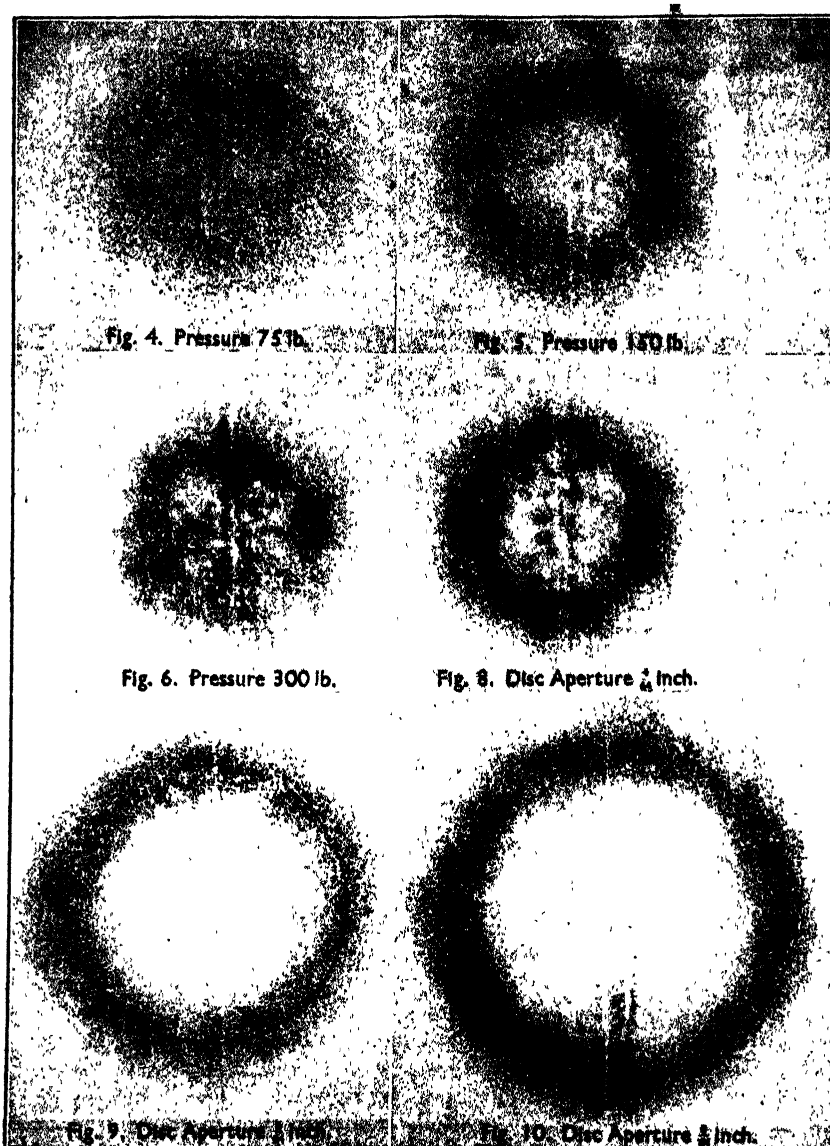
Curve A Whorl plate with six openings of diameter $\frac{8}{64}$ in. at angle of 67·5°, disk aperture, $\frac{8}{64}$ in diameter.
Curve B Whorl-plate with six openings of diameter $\frac{4}{64}$ in at angle of 22·5°, disk aperture $\frac{4}{64}$ in diameter.
Curve C: Whorl-plate with two openings of diameter $\frac{12}{64}$ in. at angle of 67·5°; disk aperture $\frac{4}{64}$ in. diameter

(iii) *Thickness of Disk.*—Increase in thickness from $\frac{2}{64}$ in. to $\frac{4}{64}$ in narrowed the angle of the cone (Fig. 7, curves C and D) and increased the size of spray droplets. Increasing the thickness to $\frac{6}{64}$ in. did not appear to have further effect. With disks thicker than $\frac{2}{64}$ in., slight variations in the alignment of the apertures caused marked unevenness in the distribution of spray.

(iv) *Depth and Shape of Whorl-chamber*—Increase in the depth of the whorl-chamber from approximately 0·08 in. to 0·24 in. had no measurable effect on the angle of the spray cone. The band of spray appeared to become slightly narrower and the droplets of spray a little coarser.

The introduction of a $\frac{1}{4}$-in.-diameter pin projecting 0·04 in. and 0·08 in. in the whorl-chamber (of depth approximately 0·12 in.) had no effect on the spray cone other than to cause a slight reduction in the angle.

(v) *Diameter of Whorl-plate Openings.*—Increasing the diameter of the whorl-plate openings from $\frac{4}{64}$ in. and $\frac{8}{64}$ in. and $\frac{12}{64}$ in. rapidly decreased the angle of the spray cone (Fig. 11). The spray droplets became slightly larger and the band of spray wider, tending to form a solid cone.



FIGS. 4, 5, AND 6. EFFECT OF INCREASING NOZZLE PRESSURE.

Spray patterns produced at 2 ft. with nozzle having six whorl-plate openings of diameter $\frac{8}{64}$ in. at angle of 45° and disk aperture $\frac{4}{64}$ in. diameter.

FIGS. 8, 9, AND 10. EFFECT OF INCREASING DIAMETER OF DISK APERTURES.

Spray patterns produced at 2 ft. with a nozzle pressure of 250 lb., and whorl-plate with six openings of $\frac{8}{64}$ in. diameter at angle of 45°.

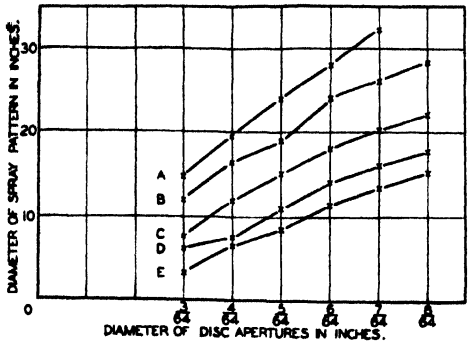


FIG. 7. EFFECT OF INCREASE IN THE DIAMETER OF DISK APERTURES ON THE DIAMETER OF SPRAY PATTERNS PRODUCED AT 2 FT WITH A NOZZLE PRESSURE OF APPROXIMATELY 250 LB.

The different curves show the effects produced when using whorl-plates of various construction, as follows :—

Curve A : Whorl-plate with two openings of diameter $\frac{5}{64}$ in. at angle of 45°.
Curve B : Whorl-plate with four openings of diameter $\frac{8}{64}$ in at angle of 67·5°.
Curve C : Whorl-plate with six openings of diameter $\frac{8}{64}$ in. at angle of 45°.
Curve D : Same whorl-plate as Curve C, but disk thickness increased to $\frac{4}{64}$ in
Curve E : Whorl-plate with two openings of diameter $\frac{12}{64}$ in at angle of 67·5°

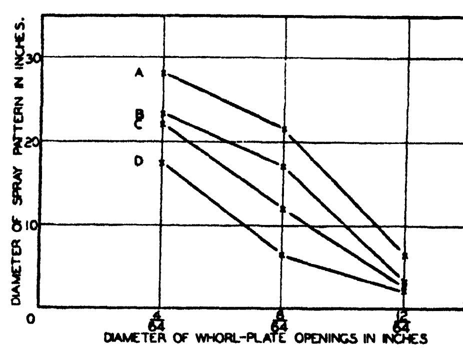


FIG 11. EFFECT OF INCREASE IN THE DIAMETER OF WHORL-PLATE OPENINGS ON THE DIAMETER OF SPRAY PATTERNS PRODUCED AT 2 FT WITH A NOZZLE PRESSURE OF APPROXIMATELY 250 LB.

The different curves show the effects produced when using whorl-plates and disks of various construction, as follows :—

Curve A : Whorl-plate with two openings at angle of 67·5° ; disk aperture $\frac{4}{64}$ in. diameter.
Curve B : Whorl-plate with two openings at angle of 67·5° ; disk aperture $\frac{3}{64}$ in. diameter.
Curve C : Whorl-plate with six openings at angle of 45° ; disk aperture $\frac{4}{64}$ in. diameter
Curve D : Whorl-plate with six openings at angle of 22·5°, disk aperture $\frac{4}{64}$ in. diameter.

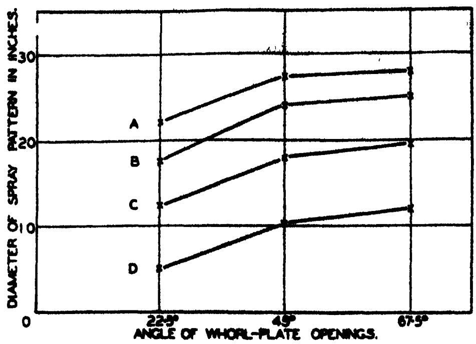


FIG. 12. EFFECT OF INCREASE IN THE ANGLE OF WHORL-PLATE OPENINGS ON THE DIAMETER OF SPRAY PATTERNS PRODUCED AT 2 FT. WITH A NOZZLE PRESSURE OF APPROXIMATELY 250 LB.

The different curves show the effects produced when using whorl-plates and disks of various construction, as follows :—

Curve A : Whorl-plate with two openings of diameter $\frac{4}{64}$ in. ; disk aperture $\frac{4}{64}$ in diameter.

Curve B : Whorl-plate with four openings of diameter $\frac{4}{64}$ in. ; disk aperture $\frac{4}{64}$ in. diameter

Curve C . Whorl-plate with six openings of diameter $\frac{8}{64}$ in. ; disk aperture $\frac{6}{64}$ in diameter.

Curve D · Whorl-plate with four openings of diameter $\frac{8}{64}$ in , disk aperture $\frac{1}{64}$ in. diameter.

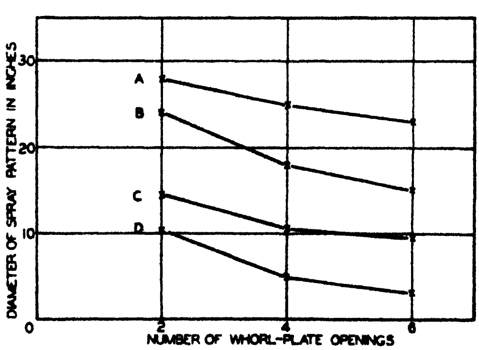


FIG. 13 EFFECT OF INCREASE IN THE NUMBER OF WHORL-PLATE OPENINGS ON THE DIAMETER OF SPRAY PATTERNS PRODUCED AT 2 FT. WITH A NOZZLE PRESSURE OF APPROXIMATELY 250 LB.

The different curves show the effects produced when using whorl-plates and disks of various construction, as follows :—

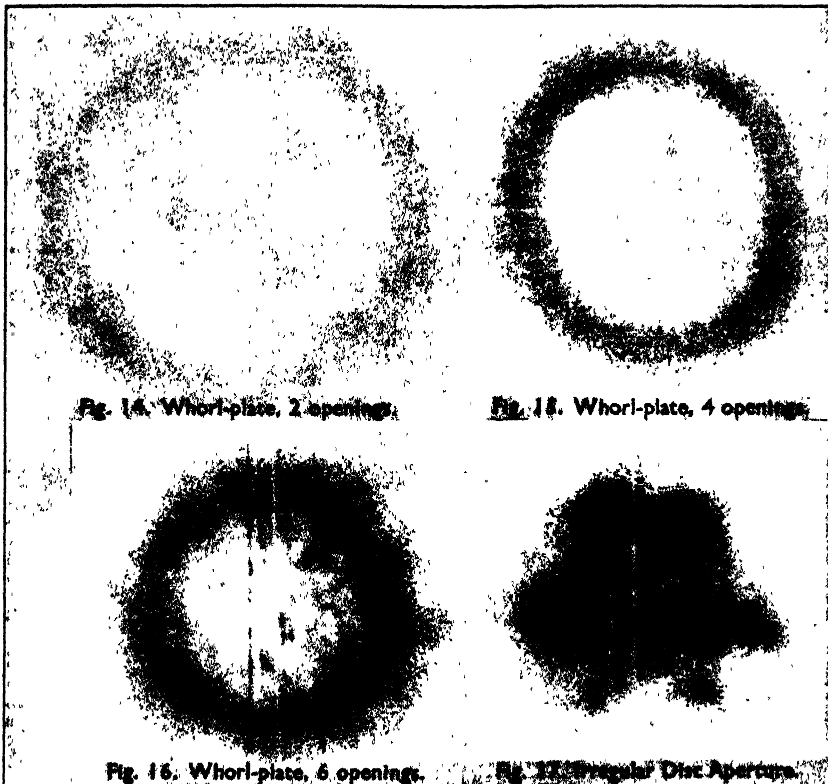
Curve A : Whorl-plate with diameter of openings $\frac{4}{64}$ in at angle of 67·5° , disk aperture $\frac{4}{64}$ in. diameter.

Curve B . Whorl-plate with diameter of openings $\frac{8}{64}$ in. at angle of 45° ; disk aperture $\frac{5}{64}$ in. diameter.

Curve C · Whorl-plate with diameter of openings $\frac{4}{64}$ in. at angle of 22·5° ; disk aperture $\frac{2}{64}$ in. diameter.

Curve D · Whorl-plate with diameter of openings $\frac{8}{64}$ in. at angle of 22·5° ; disk aperture $\frac{4}{64}$ in. diameter.

(vi) *Angle of Whorl-plate Openings.*—Increase in the angle of the whorl-plate openings from 22·5° to 45° increased the angle of the spray cone. When the angle of the openings was increased from 45° to 67·5°, there was a further increase in the angle of the cone, but not to the same extent (Fig. 12). As the angle of the openings was increased the band of spray became narrower, the cone more hollow, and the spray droplets slightly finer.



FIGS 14, 15, AND 16. EFFECT OF INCREASING NUMBER OF WHORL-PLATE OPENINGS

Spray patterns produced at 2 ft with a nozzle pressure of 250 lb and whorl-plate with openings $\frac{8}{64}$ in diameter at angle of 45° and disk aperture $\frac{5}{64}$ in diameter

FIG. 17. EFFECT OF IRREGULAR DISK APERTURE ON DISTRIBUTION OF SPRAY

(vii) *Number of Whorl-plate Openings.*—Increase in the number of openings from two to four decreased the angle of the cone. When the number of openings was increased to six, further decrease in the angle of the cone occurred, but to a less extent. (Fig. 13.) In conjunction with decrease in the angle of the cone, the band of spray became wider, the cone less hollow, and the spray droplets slightly larger (Figs. 14, 15, and 16).

(viii) *Strainer.*—The use of a strainer slightly increased the angle of the spray cone and improved the evenness of distribution, but did not appear to affect the width of the band of spray or the size of spray droplets.

(ix) *Inaccuracies in Construction.*—Any inaccuracies such as disk apertures out of centre or irregular in shape, whorl-plate openings unevenly placed, &c., caused uneven distribution of spray (Fig. 17). Similar effects were produced by partial blockage of whorl-plate or disk apertures.

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(To be continued.)

BEHAVIOUR OF NEW ZEALAND CERTIFIED CLOVERS IN NEW ZEALAND AND ABROAD.

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Two species of clover come under certification. These are—(1) white clover; (2) Montgomery red clover. In both of these there are two classes of seed—(*a*) mother; (*b*) permanent-pasture.

In red clover there is little difference between the type of mother seed and permanent-pasture seed, but in white clover two rather definite types are included. The mother-seed white clover is the tall-growing, large-leaved, highly-producing type which we regard as the very best, for both dairying and sheep-farming, where conditions are such that white clover thrives. The permanent-pasture class includes the mother-seed type "once grown," and also a smaller-leaved, somewhat lower-producing but highly persistent type which is suited excellently for harder sheep-grazing.

Throughout New Zealand 108 trials have been conducted where certified white-clover types have been tried against uncertified types and certified Montgomery red clover has been tried against broad red clover. It is largely on these trials, and on some farmers' experiences, that the following statements are based.

CERTIFIED WHITE CLOVER.

As yet there has been a very limited supply of certified mother seed of white clover. Accordingly, there are relatively few areas which have been sown down with seed of this type. Where this type occurs naturally in Hawke's Bay and in North Canterbury

it provides a remarkable bulk of luscious feed, which is utilized mostly by dairy herds or by fattening bullocks, and, further, where it has been sown in other districts suitable to rye-grass and white clover similarly excellent results are being obtained. Examples of this have been seen in Poverty Bay, South Auckland, Manawatu, Mid-Canterbury, North Otago, and Central Otago. At Ngakuru, in the Rotorua district, a large part of the success obtained on pumice country is due to the use of mother-seed white clover. In the Manawatu, also, this clover establishes and grows particularly well.

The following figures show how the certified types compare with other types when grown with rye-grass in the mowing and grazing trial at Marton. New Zealand No. 1 (mother seed) is taken as 100 in each instance.

—	Winter.	Spring.	Summer.	Autumn.	For Whole Year.	
					Relative Total Yields of Grasses and Clover.	Relative Total Yield of Clover only.
New Zealand No. 1, mother seed	100	100	100	100	100	100
New Zealand No 2, permanent-pasture seed	95	85	90	94	90	65
Kentish Wild White ..	97	82	78	90	86	50
Ordinary New Zealand ..	91	76	81	87	83	44
Imported Dutch	76	62	81	86	75	25

These figures show that in each season of the year the certified types give the best yields of herbage. In the first five columns the yields shown refer to production of both grass and clover, but the sixth column, based on dissection analyses of samples of cut herbage, gives the relative clover-yield.

The superiority of the certified types is most marked at the critical winter and summer periods, and the very early spring growth and quick autumn recovery after a dry summer are valuable qualities. Certified white clover assists tremendously in providing the dairy herd with a supply of succulent feed which can be relied on from season to season and year to year, and the farmer obtains a pasture which grows a thick mat that prevents weed-invasion and deterioration of his pasture.

White clover grown from certified mother seed is proving not only of value for the dairy herd, but also of wonderful assistance to the sheep-farmer. Its growth starts early in the spring, and it gives plenty of feed for early-lambing ewes. Many of the lambs can be fattened off in time to allow the paddocks to be shut up for a seed crop. When this has been harvested, growth soon commences again, and by the early autumn there is again first-class grazing which, during the dry year in the Manawatu in 1935, proved of great value as a green feed for lambs, and it is asserted that where sheep had access to this green feed little or no trouble was experienced with facial eczema in the flock grazing on it.

Where certified white clover has been sown in the South Island, a seed crop is generally sought, but the accompanying benefits of

better growth and a longer period of production, together with recovery after periods of drought, have made it an important grazing-crop as well. If irrigation can be practised, this clover can be used over very wide areas which now are affected by long summer droughts. In Canterbury, particularly, the application of water over the summer months enables a first-class ryegrass-white-clover pasture to be maintained where stunted brown-top and flat weeds previously existed. The resulting clover-growth can be managed either for grazing or for a seed crop.

Certified Montgomery Red Clover.

Montgomery red clover would appear to be valuable from two aspects: (1) As a seed crop for export; (2) as a constituent of the permanent pasture, and possibly as a special-purpose summer-feed pasture.

SEED-PRODUCTION OF MONTGOMERY RED CLOVER.

For seed-production Montgomery red clover has distinct possibilities, but the price of the seed must be brought more in accord with that of the ordinary broad red clover before seed-growing can safely be expanded. Montgomery red clover sets seed well in New Zealand, and, given good seasons and a moderately fertile soil, it yields almost as heavily as broad red clover. Good crops in 1934–35 yielded up to 2 sacks per acre. The highest yields of machine-dressed seed, as shown by the certification records, are as follows: Season 1931–32, 258 lb. per acre; season 1932–33, 160 lb. per acre; season 1933–34, 250 lb. per acre. Most of this seed was grown in South Canterbury and North Otago in seasons marked by drier conditions than usually prevail.

It would appear that Montgomery red clover prefers moist rather than dry conditions, and in this respect demands more moisture than broad red clover. The yield secured at Palmerston North this year from a pedigree strain was 344 lb. of machine-dressed seed per acre. In 1933 a yield of 611 lb. of seed per acre was secured, but this stand was grown under ideal conditions. One hundred and sixty-five acres came into certification in the 1933–34 season, the total amount of machine-dressed certified seed being 17,263 lb., an average of 105 lb. per acre. There was a considerable increase in 1934–35, when 392 acres yielded 32,193 lb of machine-dressed certified seed.

The practice in seed-production with Montgomery red clover in New Zealand is somewhat similar to that with broad red clover: a hay crop is taken in November to December and the aftermath shut up for a seed crop. It is highly problematical whether this practice of a hay crop is preferable to grazing the stand up till possibly the end of November, but no definite data are available on this point. It has been shown definitely that a stand of Montgomery red clover is readily "smothered" by allowing a dense crop to lodge, and it would appear that a reasonable grazing practice is better for the stand than either haying or seeding. One of the oldest stands of Montgomery red clover in New Zealand is that in the Leeston district sown there by the Canterbury Seed

Co. in 1930. This has been hayed or seeded each year, and in 1934 it produced a very heavy crop. It would appear, however, that reseeding has had a good deal to do with the persistency of this stand.

MONTGOMERY RED CLOVER IN PERMANENT PASTURE.

As a constituent of the permanent pasture Montgomery red clover is worthy of a place, and is to be preferred to the ordinary broad red clover on account of its more persistent nature and less

FIG. 1. PERMANENT PASTURE ON LIGHT, SANDY, AND STONY RIVER-ACCRETION COUNTRY SOWN OUT WITH CERTIFIED PERENNIAL RYE-GRASS, COCKSFOOT, CERTIFIED MOTHER-SEED WHITE CLOVER, AND CERTIFIED MONTGOMERY RED CLOVER.

The growth shown is dominantly Montgomery red clover and white clover. The pasture has got away somewhat owing to the wet summer experienced this season Photo taken 21/3/36 [*Photo by E. Bruce Levy.*

inclination to get out of hand in the first and second years of the life of the pasture. The price of the seed, however, must conform more to the price of broad red clover than it does at present before a general use will be made of this species as a pasture constituent. Montgomery red clover is essentially a summer pasture-plant, and it would appear as if this is its greatest *rôle* in the pasture. In this respect it may serve well as a dominant constituent of special summer pastures that are managed so as to give optimum growing-conditions for Montgomery red clover—*i.e.*, grazed during the spring and then spelled, and reserved to fill the summer need, the spelling coinciding with the period of optimum

growth for this red clover. Special pastures of cocksfoot, Montgomery red clover, and certified mother white clover may prove invaluable for this summer grazing.

ESTABLISHMENT.

Field-plot trials show that establishment of white and red clover is extraordinarily uncertain, especially where dry conditions have followed the sowings. In Canterbury, for example, in 1930, 1932–33, and 1933–34, with spring sowings very poor establishment of clover has resulted. Spring sowings in North Island districts subject to drought failed also in 1934.

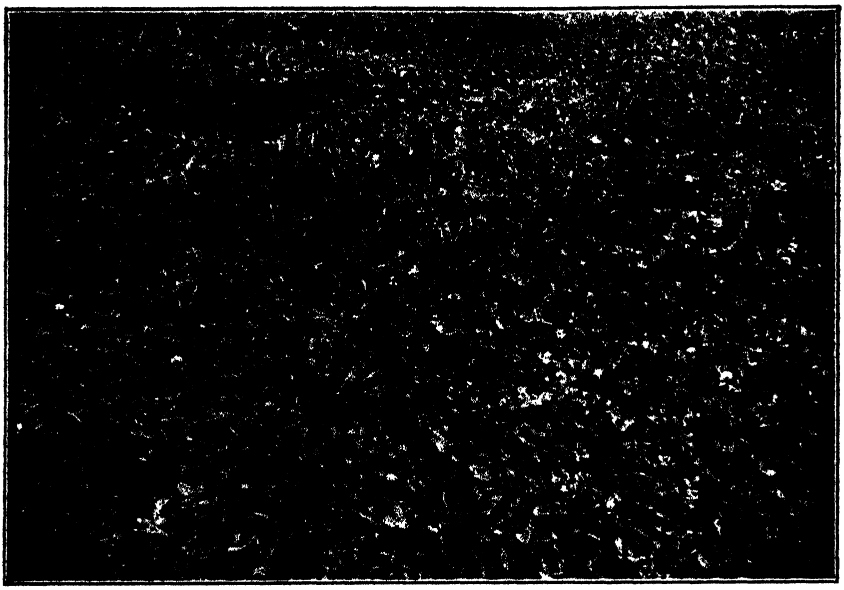


FIG. 2. PERMANENT PASTURE ON LIGHT, SANDY RIVER-ACCRETION COUNTRY SHOWING WONDERFUL GROWTH OF CERTIFIED MOTHER-SEED WHITE CLOVER AND MONTGOMERY RED CLOVER.

The wet summer has contributed greatly to this sward. Photo taken 21/3/36.

[*Photo by E. Bruce Levy.*

Consolidation of the seed-bed is a vital factor in clover-establishment. This has frequently been shown in our trials where the small area sown could not be rolled. Late autumn sowing—after the end of March—prejudices the chances of a good clover strike. It would appear that autumn sowing, in both North and South Islands, where dry summers are experienced, is distinctly preferable to spring sowings where clovers are concerned. Spring sowing is successful in districts of high rainfall, or where summer droughts are not experienced.

In sowing down for dual seed-production it is essential that both the certified perennial rye-grass, and the certified mother-seed

of white clover establish. When the stand is allowed to run to a rye-grass seed-crop the first year, and heavy lodging occurs, the white clover sown may be entirely smothered out, and subsequent ingress of an inferior type of "volunteer" white clover would give disappointing results and cause some concern when the clover crop was rejected for certification on account of being of inferior type.

From the foregoing remarks it will be seen that clover-establishment in dry areas, and in Canterbury and Central Otago particularly, is a problem requiring serious consideration.

FIG. 3. PERMANENT PASTURE ON HEAVY CLAY WETTISH COUNTRY THAT IS INCLINED TO RUN BACK TO BROWN-TOP AND RUSHES.

Photo shows the growth possible here using certified mother-seed white clover and Montgomery red clover in the mixture. Photo taken 21/3/36.

[*Photo by E Bruce Levy.*

EFFECT OF CLOVER ON THE GRASSES OF THE SWARD.

During the course of strain trials throughout New Zealand, ample evidence has been secured relative to the beneficial effect that clover has on the associated grasses of the sward, and instances have been recorded where the differences could be measured in terms of ammoniated superphosphate—*i.e.*, the plots sown with good persistent strains of certified white clover appeared as if they had been top-dressed with 3 cwt. to 4 cwt. ammoniated superphosphate an acre, as against an appearance of no top-dressing on plots on which bad types of white clover were sown or where clover had failed to establish.

PERSISTENCY.

In all trials persistency has been a marked feature of all certified clovers, and it would appear as if this persistency will have an enormous influence in extending the range of the species as far as soil-type is concerned. In the past a great deal was said of certain types of country being unable to "hold" certain species permanently, whereas, to-day, by the use of certified strains, on account of their greater persistency, the same country is being permanently grassed.

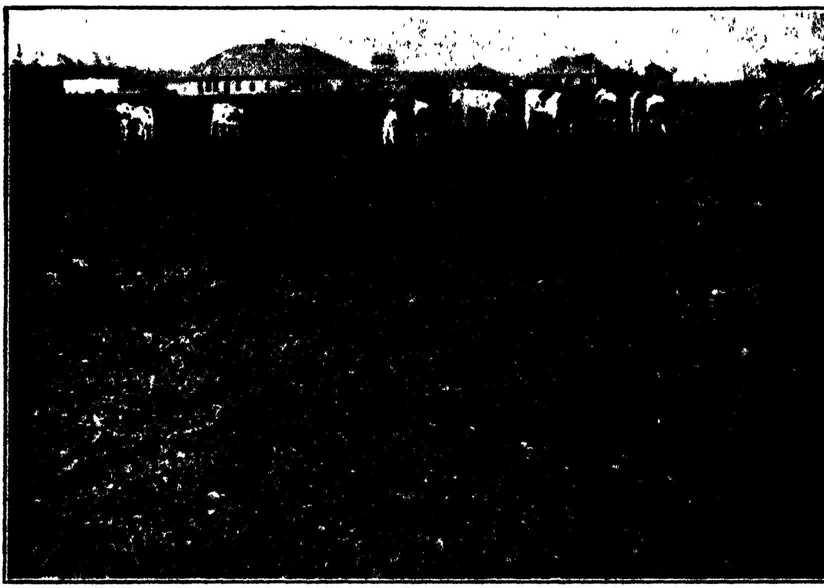


FIG. 4. PERMANENT PASTURE ONE YEAR OLD AT TIME OF PHOTO, ON A GOOD RIVER ALLUVIAL SOIL AT MASSEY AGRICULTURAL COLLEGE.

Photo shows wonderful early establishment and growth of certified mother-seed white clover and Montgomery red clover, together with certified perennial rye-grass. Photo taken 21/3/36. [Photo by E. Bruce Levy.

CERTIFIED CLOVERS OVERSEAS.

Information regarding the performance of New Zealand certified clovers when grown overseas has been drawn from a summary of reports received from persons or institutions supplied with New Zealand seeds for testing purposes.

In the British Isles the certified types do well, and the growth characteristics seem to be similar to those in New Zealand. In practically every case the mother-seed type is superior to the permanent-pasture type. In Great Britain the New Zealand strains are being recommended freely for use in short-term leys.

From Denmark one report indicates good results, and superiority to Danish "Morso," but another report shows little superiority to Danish strains.

New Zealand strains have proved suitable for the eastern coastal regions of the United States of America and Canada, extending within the latitudes 40° to 50° north. They have grown particularly well in British Columbia along the western coastal region of Canada. Anywhere inland in America or in Canada winters are apparently too severe, and winter killing of clover is general. Although winter killing has occurred in Alberta, Manitoba, Ontario, Quebec, and Kansas, a certain amount of satisfactory growth has been made inland at Ottawa, Maryland, Ohio, and at one place in Northern Ontario.

FIG. 5. PURE SWARD OF CERTIFIED PERENNIAL RYE-GRASS ONE YEAR OLD SHOWING ABSENCE OF WHITE CLOVER

The herbage was inclined to be harsh and dry, with much dry bottom and inclination to be affected with rust Compare with Fig 6.

[*Photo by E. Bruce Levy.*

India and Burma have tropical climates to which our species are quite unsuited. Fiji and the Hawaiian Islands also are too tropical.

The New Zealand strains have proved excellent for pasture purposes in Tasmania, and are successful on the coastal areas of New South Wales, Victoria, and South Australia. Further inland droughts are the limiting factor unless irrigation is possible.

In South Africa unusual climatic conditions are met. Kenya Colony is in the equatorial regions, but all farming is done at high altitudes—up to 9,000 ft. above sea-level. Some of these parts are relatively cool and moist and have a climate similar to that of our North Island, so New Zealand clovers can be grown there.

In the Orange Free State and Natal, in South Africa, the summer is the rainy season, and the winters are dry and cold. Farming there is done at altitudes up to 6,000 ft., and in some parts irrigation is necessary in the winter months. Mother-seed white clover has proved particularly hardy under these conditions, and helps materially in providing winter feed.

Summarizing fifty-five replies received from overseas testing-stations, at twenty-four places certified clovers did well or excellently; at fifteen places, moderately well; at fifteen places, badly; and at one place the test was inconclusive.

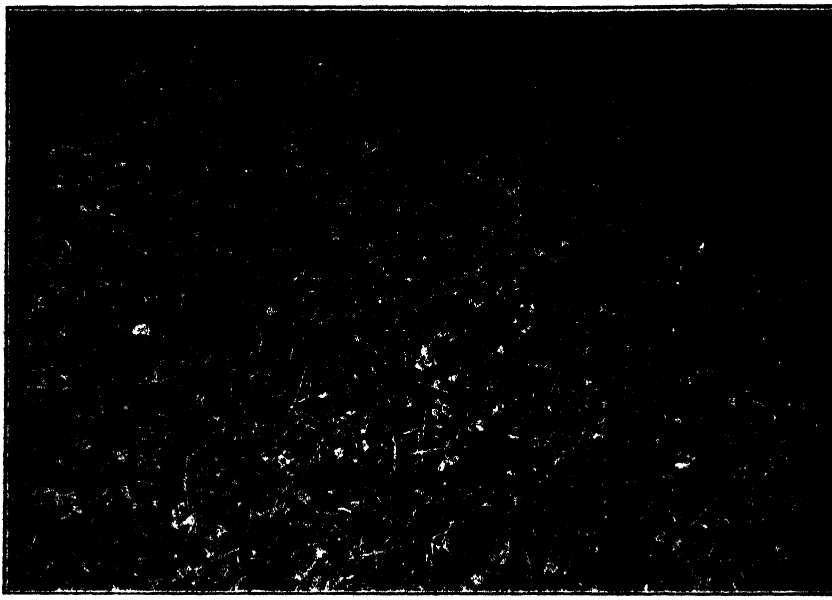


FIG. 6. SHOWING SWARD OF CERTIFIED PERENNIAL RYE-GRASS AND PEDIGREE WHITE CLOVER SAME AGE AND SOIL TYPE AS PASTURE SHOWN IN FIG. 5.

The presence of the clover has improved the health and quality of the rye-grass, which is fresh and vigorous, and the two together have given a high production and highly palatable sward. [*Photo by E. Bruce Levy.*

Few overseas stations have tested New-Zealand-grown Montgomery red clover, but reports received indicate that it thrives in the same situations as those already mentioned as being where certified white clover will grow. The one exception is Ottawa, where red-clover plants are very susceptible to disease and winter killing. Three British plant-testing stations state definitely that the New-Zealand-grown Montgomery red clover is indistinguishable from British-grown Montgomery red clover.

CONCLUSION.

In regard to New Zealand certified white clover, all available evidence goes to show that in certified New Zealand mother-seed white clover, and pedigree selections of this type, New Zealand

has a valuable pasture-plant, and its advent is of equal importance to that of certified perennial rye-grass. As a pasture-plant it is most useful; and the encouraging overseas reports on this type go to show that its seed is a valuable, readily exportable commodity. In the case of Montgomery red clover, every effort should be made to exploit the British market as an outlet for New-Zealand-grown certified seed of this species, and an endeavour should be made to bring the price more in conformity with that of broad red clover. This would have a marked effect on its wider use in New Zealand itself.

FARMING IN THE AUCKLAND PROVINCE.

OBSERVATIONS ON FARM-MANAGEMENT METHODS.

P W. SMALLFIELD, Fields Superintendent, Auckland

VI. THE CAPE COLVILLE PENINSULA.

THE Cape Colville Peninsula(30) may be said to extend from Cape Colville to Te Aroha (strictly speaking the peninsula is terminated by a line drawn between the mouths of the Waihou and Tairua Rivers); from Cape Colville to Te Aroha the peninsula has a length of eighty miles and an average breadth of fifteen miles. The land surface is rugged and broken, and the mountains of the main divide rise to an elevation of 2,000 ft. to 3,000 ft. The highest mountains are Moehau (2,900 ft.) in the extreme north and Te Aroha (3,126 ft.) in the south. There is very little flat or gently undulating land. On the east coast the land is penetrated by a number of inlets and tidal estuaries of the larger streams: inland of Mercury Bay, on the north side of Whitianga Harbour, there is a plain of some five miles by two miles in extent, and lesser flats occur in the stream valleys of Tairua and Whangapoua Harbours. The Waihi Plain, in the south-east of Ohinemuri County, is six to seven miles in length east to west and three to four miles across, but is not alluvial in origin. On the west side of the peninsula inlets and tidal streams are absent, or the latter are only tidal for a short distance: at Coromandel there is an area of 2,000 to 3,000 acres of flat land fringing the harbour, and further farming-land extends up the Waiau Valley. The oldest rocks of the peninsula are argillites and greywackes, which were covered by volcanic eruptions in the Tertiary period, first by vast accumulations of andesitic tuffs, breccias, and lava-flows, and finally, at the end of the period, further eruptions covered large areas with rhyolite. Most of the soils are formed from semi-basic or acidic volcanic material(30).

The climate of the Colville Peninsula is very similar to that of North Auckland. The rainfall varies, depending on the configuration of the land, but the mean annual rainfall is probably about 50 in.; Waihi has a mean annual rainfall of 87 in.

Originally most of the country was heavily forested; the kauri-pine, as in North Auckland, covered large areas. The exploitation of kauri-timber, kauri-gum, and gold on the Colville Peninsula has given employment to large numbers of men for many years, has enriched

Auckland City, but has left merely the "bare bones" of land on the peninsula. The felling and removal of the kauri-pine caused the destruction of most of the original forest; the gum-digger followed, and he burnt to clear for his digging operations. Secondary growth

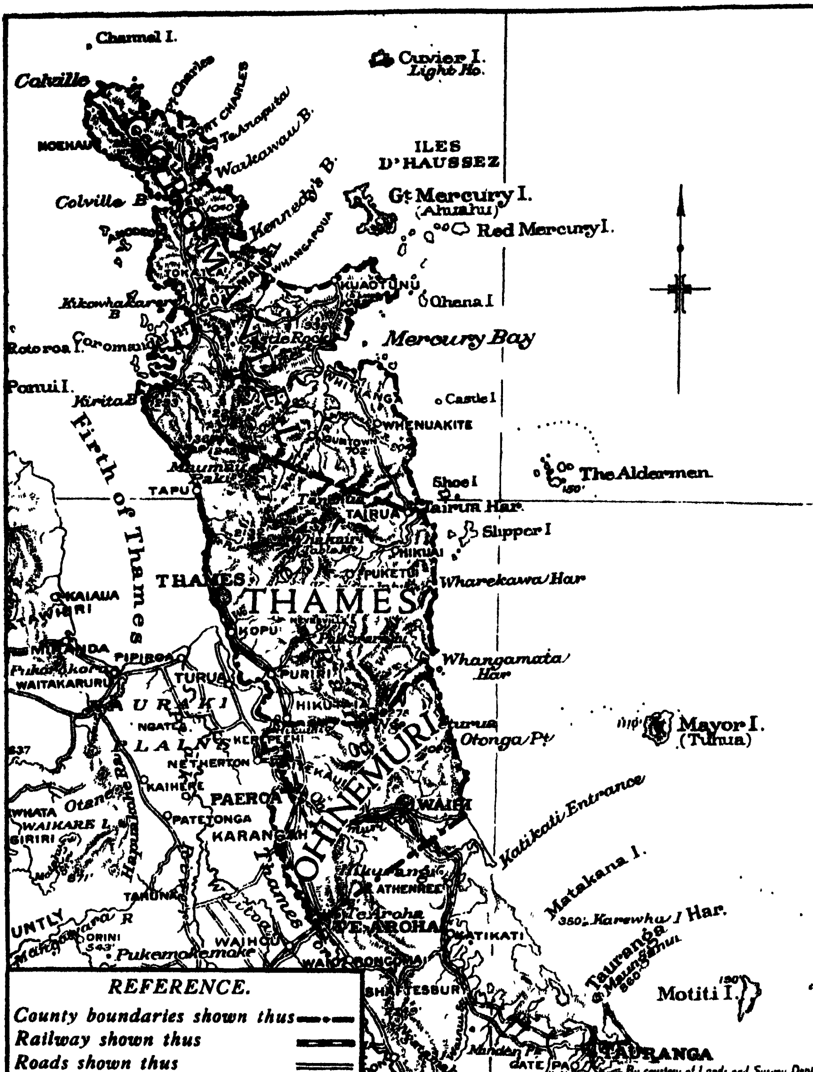


FIG. 13. MAP SHOWING COROMANDEL, THAMES, AND OHINEMURI COUNTIES.

followed repeated burning, and now most of the peninsula is in stunted manuka scrub. Farm lands occupy only a small part of the area; dairying is carried on on the flat and gently undulating land; sheep-farming on danthonia hill-pastures, chiefly on hills the soils of which are derived from andesitic rocks.

*Table VIII.—Crops and Live-stock : Table showing Areas in Crops and Pasture and Numbers of Live-stock in Cape Colville Counties, 1933–34 Season.**

County.	Crops.			Live-stock.			
	Annual Crops.	Pasture.	Pasture cut for Hay and Silage.	Dairy Cows.	Other Cattle.	Sheep shorn.	Pigs.
	Acres.	Acres.	Acres.				
Coromandel ..	365	72,980	611	6,305	9,305	57,369	1,500
Thames ..	621	31,374	2,227	10,862	6,195	10,753	3,730
Ohinemuri ..	1,198	50,692	6,006	19,230	12,020	10,518	7,269
	2,184	155,046	8,844	36,397	27,520	78,640	12,499

* From Agricultural and Pastoral Statistics.

The extension of farming on the peninsula is dependent on the establishment and maintenance of hill pastures of danthonia. If the rainfall were less or the summers generally dry this could be done on most of the andesitic country. This land is dry in the summer : with a run of dry summers and burning, the danthonia pastures can be kept clean and the danthonia area extended. A wet summer means no burning or poor burns and a rapid invasion of manuka and bracken fern. Most of the country is more suitable for forests than pastures, and the establishment of large State forestry plantations at Whangamata may be the beginning of the reafforestation of the peninsula. The alternative to danthonia pastures and burning is the establishment of mixed pastures of grasses and clovers with the aid of phosphatic top-dressing—high farming—but most of the hill country is too high, steep, and broken for this course ever to be payable.

COROMANDEL COUNTY.

21st January, 1936 : Coromandel to Te Rerenga.—The road from Coromandel to Whangapoua Harbour crosses the main divide over the Whangapoua Saddle (1,140 ft.) and then follows the valley of the Waitikauri Creek to Te Rerenga. Surface-sown hill pastures in the valleys consists of danthonia, brown-top, and *Eragrostis Brownii*. Farmers are becoming anxious over the continuous wet summer weather, which will prevent or spoil hill-country burns. Whilst a wet summer means plenty of feed on dairy-farms, it prevents the peninsula farmers getting clean burns. All through these danthonia pastures are small manuka seedlings, which, if not burnt off, will grow and increase, and the hills will revert to 4 ft. to 5 ft. dense manuka, which will require cutting and reseeding to get the land back to pasture. Manuka and bracken fern are here the chief secondary-growth plants ; hard fern and water fern and piripiri are not troublesome, as on the Western Upland. With regular burning an almost pure danthonia sward is maintained. This system does not allow clovers and better grasses to associate with the danthonia. Production from pure danthonia swards is low, but they are probably the most economic pastures for this class of

country, and are used for grazing Romney sheep, the marketable products being wool and store sheep. For the year ended the 30th April, 1935, the flock sheep for Coromandel and Thames counties consisted of—

County.	Wethers.	Breeding-ewes.	Dry Ewes.	Lambs.
Coromandel ..	6,554	41,514	812	17,486
Thames	1,090	7,357	139	2,548

With the advent of good roads, farm-development will probably follow the lines of first improving the easily ploughable land in the river and stream valleys. Here in the valleys behind Whangapoua Harbour are many hundreds of acres of flat and easily ploughable land that could be developed to grow good pastures of rye-grass, paspalum, and white clover if top-dressed. Some areas are now in paspalum and white clover, and other areas are in danthonia and brown-top. Development of these flats would help to increase the winter carrying-capacity of the farms and give more stock for the spring and summer grazing of the hill country. At both Coromandel and Mercury Bay areas of flat land have been developed for dairy-farming, and higher prices for wool and store sheep and cattle may induce the development of other areas for sheep-farming. From the flats at Te Rerenga, Castle Rock (1,724 ft.), lying at the head of the Opitonui Creek, makes a striking feature of the landscape: the mountain rises from a comparatively low saddle, having an elevation of 1,080 ft., at first with moderately steep slopes and finally with precipitous cliffs for the upper 400 ft.

THAMES COUNTY.

22nd January, 1936: Tapu to Hikutaia.—From Tapu to Thames the road follows the coast; there is little ploughable land, but many of the foothills are danthonia-pasture land. The most fertile and closely settled portion of the county lies between Thames and Hikutaia, and consists of a narrow strip of land between the mountains and the Waihou River. The farming-lands consist of gently rolling foothills merging into flat alluvial land on the banks of the river. A wet day, with wind and driving squalls of rain. Everywhere hay is lying out; most of it spoilt; in places the damaged hay has been raked up and burnt. A great deal of hay has been lost this season all through the Auckland Province. About here paspalum is a common pasture-plant and paspalum fields are throwing a great deal of feed, and the surplus growth could well be made into silage. There are also numerous patches of maize for autumn green feed, which, if the season continues wet, will not be required. Annual crops for summer and autumn feeding are generally satisfactory in a normal year, but in a very dry year they fail, and in a wet year like the present they are not required.

OHINEMURI COUNTY.

23rd January, 1936: Hikutaia to Waihi.—The farming conditions from Hikutaia to Paeroa are generally similar to those just described from Thames to Hikutaia. The Waihi Plain is a flat to gently undulating area about six miles long by four miles wide; the soil is light and was

originally covered in fern and manuka. The farm lands have been developed since 1912. Ploughed, grassed, and phosphated, the land carries fair pastures, but recently experimental work has shown that a strong white-clover growth is dependent on potash manuring. The rainfall at Waihi is 87 in. per annum, and this may account for the potash deficiency. In top-dressing practice potash is not nearly as important as phosphates. On most soils white-clover growth is dependent on phosphatic manuring: some soils require lime in addition to phosphates, and, again, other soils also require the addition of potash. Broadly speaking, potash top-dressing is required only on soils which will not grow legumes well without its aid. Here at Waihi the potash responses are most marked in the vigour and growth of white clover and *Lotus major* (with a corresponding vigour and growth of perennial rye) in colour of the pastures and palatability of the herbage: plots and fields dressed with potash are now closely grazed, whilst the undressed areas carry much seed-head.

VII. Farm Management.

Our journeys through the farming districts of the Auckland Province have covered many hundreds of miles, and we have seen and discussed many things—topography and climate, soils and pastures, crops and live-stock, and methods of farming. With a warm and humid climate, Auckland conditions are suitable for grass-farming. In some respects the soils are peculiar: areas of the older soils have been badly leached—*e.g.*, the gumland and ironstone soils of North Auckland. Over large areas the soils are composed of volcanic ash showers, and, with the exception of comparatively small areas, all soils are deficient in available phosphates, many in lime, and some in potash. Profitable farming is dependent on building up soil-fertility by top-dressing and stocking. High-class pastures and high-class stock (the dairy cow and the breeding-ewe) are the aim—not, of course, always secured, for soil, climate, topography, finance, the value of farm-produce, and the inherent difficulties of grass-farming may one or all lead to a low level of farming. On the steep hill country high rainfall (and often a soil of good moisture-holding capacity) brings trouble in the form of secondary growth. High rainfall and high farming on the flat and undulating land make profitable the dairying and stock-fattening farm enterprises, but the steep hill-country could be better farmed if the rainfall was lower and stable pastures of danthonia and brown-top covered all the high country.

CROPS AND PASTURES.

There are in the North Auckland and South Auckland Land Districts seven million acres in occupation, of which four and a third million acres are cultivated; of the cultivated land nearly four million acres are in the pasture and only eighty thousand acres in annual crops Pasture-land consists of surface-sown pastures and pastures on ploughed land; the former are situated on hill country originally covered in bush, fern, and scrub, and on drained swamp land; the ploughed grassland is on flat to undulating country originally in fern or scrub, or bush country felled many years ago and subsequently stumped and ploughed Hill-country pastures vary considerably in composition and productivity. Danthonia and brown-top are the important constituents of most hill pastures, and with these plants are found perennial rye-grass, crested

dogstail, cocksfoot, paspalum, Chewings fescue, ratstail, white and suckling clovers, along with numerous weeds. These pastures are used mainly for grazing Romney sheep and beef cattle. Sheep are the main stock, but about one cattle beast to every ten sheep has to be carried to control pasture-growth and crush out second growth, for fern, manuka, and piripiri are the bane of the hill-country farmer. Pastures on ploughed land also vary considerably in composition and productivity—from pastures of rye-grass, cocksfoot or paspalum, and white clover, producing 200 lb. of butterfat, to pastures producing only 40 lb. to 50 lb. of butterfat per acre, and where one or more of the grasses and clovers such as Yorkshire fog, sweet vernal, goose-grass, brown-top, suckling clover, or *Lotus hispidus* are dominant. Variations are due to soil fertility and management, but the general aim is to secure a pasture in which perennial rye-grass and white clover are dominant, and with which are associated cocksfoot or paspalum. Primarily it is a matter of good establishment and, subsequently, of top-dressing, stocking, and management.

Phosphatic top-dressing is essential on most Auckland dairying and fattening grassland. For the 1933–34 season the following areas were top-dressed in the North and South Auckland Land Districts :—

	Acres
Fertilizers only	824,426
Lime only	40,935
Fertilizers and lime	448,203
	1,313,564

Superphosphate is the most widely used fertilizer for top-dressing ; on the leached soils, such as those of the podsol type, lime is necessary to get the best results from superphosphate. Basic slag and rock phosphates are also applied : slag was used extensively in the past and would again be used if superphosphate had not a price advantage. Potassic and nitrogenous fertilizers are applied only to a limited extent. Top-dressing is usually carried out annually, using 2 cwt. to 3 cwt. of phosphatic fertilizer, and early autumn top-dressing gives the best results : this increases the autumn and early winter growth of grass, and thus raises the winter carrying-capacity. The effect of phosphatic top-dressing is to increase the white-clover growth. Stocking is important, and it is the stock consuming the clover and grass growth and turning it into manure that finally gives a ryegrass-dominant pasture. The technique of high grass-farming was evolved on the light soils of the Waikato—light soils, yet soils of good summer moisture-holding capacity ; soils that stand heavy stocking without poaching. Attempts to transfer the technique to heavy land are not always successful, for the keynote of success is heavy stocking : wet land poaches badly in the winter, and this leads to lessened pasture-production and the invasion of weeds, particularly buttercup, pennyroyal, and thistles. The introduction of paspalum has, however, made possible high grass-farming on large areas of heavy land, for paspalum forms a strong turf and grows well in the summer : if the summer growth is controlled it combines well with rye-grass and white clover.

The bulk of the supplementary feed for periods of grass-shortage is saved as hay and silage from permanent pastures, and for the 1933–34

season 190,972 acres were saved for hay and 53,235 acres for silage in the North and South Auckland Land Districts Crops grown were as follows :—

	Acres
Cereals	15,729
Green and root crops	63,464
Lucerne	4,161

Oats and maize are the two important cereal crops. Oats for chaff and threshing occupied 4,479 acres, and green-feed oats 1,348 acres; maize for grain occupied 4,138 acres, and 4,769 acres were grown for green feed and silage. Swedes and soft turnips occupied 51,031 acres, and the remaining area under green and root crops was composed of rape, kale, chou moellier, mangels, millet, cattle-marrows, and potatoes. The acreage under lucerne is gradually increasing, and the crop will probably be used more extensively in the future on all the light, well-drained land of the province.

LIVE-STOCK.

Auckland farms may be classified according to the class of live-stock grazed and the marketable products produced. Two chief divisions may be made—viz., dairy-farms and sheep and cattle-grazing farms. On the former are grazed nine hundred thousand milking-cows and necessary replacement stock, and on the latter nearly one and three-quarter million breeding-ewes, together with dry sheep, breeding beef-cows, and dry cattle The live-stock grazed in the North and South Auckland Land Districts during the 1933–34 season were as follows —

Dairy Cattle, at 31st January, 1934

Cows in milk	906,280
Cows dry	53,078
Heifers, one to two years	185,060
Calves	190,237
Bulls, two years and over	28,154
	1,362,809

Beef Cattle, at 31st January, 1934.

Cows and heifers, over two years	108,269
Steers, over two years	97,577
*Steers and heifers, one year to two years ..	77,841
*Calves	85,101
Bulls, two years and over	3,114
	371,902

Sheep, at 30th April, 1934.

Breeding-ewes	1,693,481
Dry ewes	53,014
Wethers	227,067
Lambs	564,478
Rams	46,838
	2,584,878†

* Includes young dairy and beef bulls.

† Auckland Sheep District, which includes Opotiki (Gisborne), Ohura (Taranaki), and Kaitieke (Wellington) counties, had a total of 2,937,554 sheep.

Auckland farming districts are not self-supporting in cattle or sheep. The fat-lamb-raising and cattle-fattening industries of the Waikato draw supplies of ewes, wethers, and cattle from the East Coast districts. In the past large numbers of dairy heifers were brought into the Waikato from Taranaki.

SHEEP- AND CATTLE-GRAZING FARMS.

Sheep and cattle enterprises show considerable variation. Owing to the general high rainfall, most land in the province is potential milk-producing or fattening land if highly farmed, so that there is no sharp district division in sheep and cattle enterprises between farms producing store and fat stock which is found in some parts of New Zealand. Farms may be divided into farms on which both sheep and cattle are carried and farms grazing cattle alone. Again, the sheep-farms may be divided into farms on which the sheep flocks are maintained or partially maintained by farm breeding and farms on which the ewe flocks are maintained by buying-in. The former are represented by farms on surface-sown hill grassland and may, depending on the class of pasture, produce store or fat stock, and the latter by farms with top-dressed ploughed grassland producing lamb, mutton, and beef. In neither class are large sheep flocks the rule, and quite small flocks are more common than large ones. The size of flocks in four large sheep-farming counties are shown below:—

Size of Flock.	Number of Owners in Counties.			
	Raglan.	Waitomo.	Whangarei.	Waipa.
1– 200	47	158	144	121
201– 500	74	171	93	52
501– 1,000	82	115	56	39
1,001– 2,500	82	90	32	33
2,501– 5,000	22	13	5	5
5,001– 7,500	4	3	1	..
7,501–10,000	1	1	..	..

Raglan and Whangarei counties have both extensive sheep-grazing farms on surface-sown hill country and intensive fat-lamb-raising farms on ploughed grassland. Waitomo County has extensive hill-country sheep-farms; but dairy-farmers there also keep small flocks of sheep for the control of ragwort. Waipa County is a typical fat-lamb-raising county where flocks are maintained by buying in ewes.

In Auckland farming, fat-lamb raising on high-class pasture-land ranks with dairying as a really efficient industry: extensive hill-country sheep-farming is not generally as efficient, owing, in many places, to the climate not being really suited for the maintenance of stable hill-country pastures. Fat-lamb raising is carried on chiefly on the basic volcanic soil areas of North and South Auckland and on the plains of the Middle Waikato Basin. The fat-lamb raiser relies almost entirely on permanent grass: well-managed farms have a carrying-capacity of three to four ewes per acre, and the grassland is usually top-dressed with 2 cwt. of phosphates per annum. Ewe flocks are maintained with annual drafts of four- and five-year-old Romney

ewes : some farmers to avoid annually changing most of the flock add some two-tooth ewes with each annual draft. The ewes are purchased in January and February, put out with Southdown rams at the end of February or early in March : a lambing percentage of 100 is looked for, and usually 90 per cent. of the lambs are sent away fat off their mothers by the end of December. The value of the wool-clip compensates for ewe losses and the loss in value of ewes—usually a price difference of 5s. to 8s. between a breeding-ewe when bought and a fat ewe sold at the end of the season. The fat-lamb raiser usually runs cattle as well as sheep, in order to control the summer growth of grass, using either two-, three-, or four-year bullocks for fattening or dairy heifers.

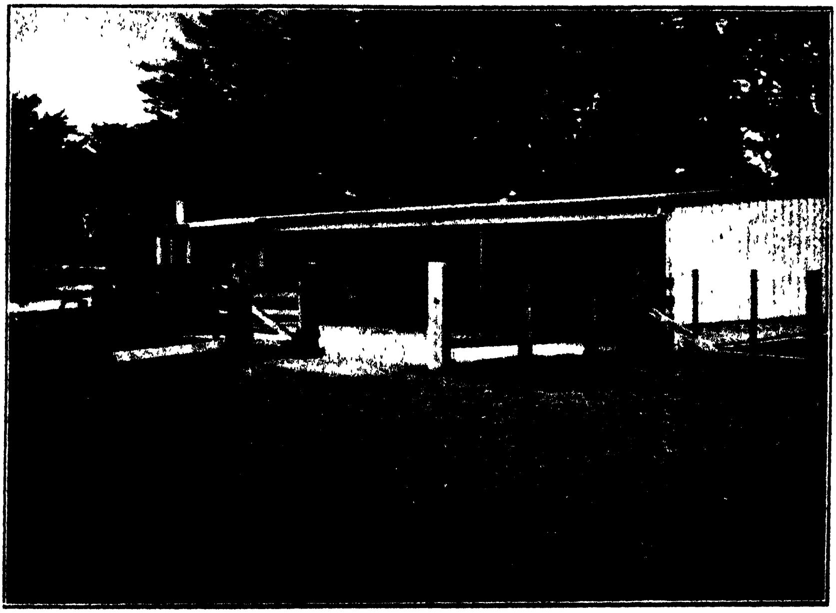


FIG. 14. MODERN MILKING-SHED, RUAKURA FARM OF INSTRUCTION, HAMILTON.

Dairy-farm organization centres round the milking-shed . the modern walk-through shed, with concrete floors and yards, milking-machines, separator, and ample boiling and cleaning water-supply facilities has made possible the efficient utilization of labour. [*Photo by H. Drake.*

DAIRY-FARMING.

Dairy-farm organization centres round the milking-shed : the modern walk-through shed, with concrete floors and yards, milking-machines, separator, and ample supplies of boiling and cleaning water has made possible the efficient utilization of labour. One man with machines can milk up to 30 to 35 cows ; a man and a youth, 50 to 65 cows ; two men, 80 to 85 ; and three men, 100 to 110 cows. Hence, on good dairying-land common farm sizes are 50-acre farms milking 30 to 35 cows, 100-acre farms milking 50 to 65 cows, 150- to 200-acre farms milking 80 to 100 cows. Most Auckland herds over twenty cows are milked by machines ; in January, 1934, there were 906,280 cows in milk, of which 736,532 cows were milked by machines, there being

12,643 milking-machine plants. The Dairy Industry Commission(31), commenting on "Labour in relation to Production," stated: "Dairying in New Zealand is organized largely on the basis of family labour, the efficiency of which varies considerably. There are, however, instances of one unit of male labour milking up to forty cows, and a range of between fifteen and thirty-five cows per male unit is common. Thus the efficiency of farm labour measured in butterfat output shows wide variations, and may range from 2,700 lb. to 12,600 lb. of butterfat on farms where dairying is the main source of income. High per-acre production of butterfat is, however, generally associated with high labour efficiency. With improved herds and through widespread use of labour-saving machinery, the general level of labour efficiency has has been raised materially during recent years, and to-day 6,000 lb. of butterfat per male unit of labour should be viewed as the minimum for machine-milked herds." A survey(32) of 259 Auckland dairy-farms, with machine-milked herds, gave the following particulars regarding butterfat-production and labour efficiency:—

——	North Auckland.	South Auckland.
Number of farms	115	144
Number of cows	6,342	9,934
Average butterfat-production per acre ..	92·98 lb.	143·69 lb.
Average butterfat-production per cow	226·0 lb.	263·2 lb.
Average number of cows per 100 acres.. ..	41·4	54·6
Average butterfat per labour unit	4,708 lb.	6,024 lb.
Average cows per labour unit	20·83	23·43

The labour required for milking can do all the necessary farm-work of feeding, pasture maintenance and repairs, but normally requires supplementing during hay and silage harvesting. Machinery has greatly lessened the work of harvesting, and since the introduction of grass ensilage there has been a great improvement in the design of small sweeps for handling grass for hay or silage.

Better winter and early spring feeding of dairy cows would help considerably in increasing butterfat-production on the average Auckland dairy-farm. Good management aims at drying the cows off in good condition in the early winter before grass-growth goes off entirely: if dried off in good condition cows will hold their condition on hay and silage or hay and root feeding, but it is impossible to build up condition in the depth of winter. Supplementary feeding should start in the late autumn or early winter, before it is actually required; if this is done, from a third to a half of the farm can be closed up at the end of May or early June and the grass-growth held over for feeding newly calved cows in July or early August. From the middle of August to the middle of September grass-growth is usually poor; special feed provision for this period consists of temporary pastures of Italian rye-grass, green cereals or permanent pastures top-dressed with ammoniated superphosphate.

In addition to butterfat, pigs are a source of profit on Auckland dairy-farms, and with good management it is possible to secure from 1½d. to 2d. per pound of butterfat from pigs. The chief difficulty in pig-keeping is to regulate the supply of pigs to the skim-milk supply: to make the fullest use of skim-milk the wintering of pigs is often a

FIG. 15. A ONE-HORSE SWEEP.

Machinery has greatly lessened the work of harvesting, and since the introduction of grass-ensilage there has been a great improvement in the design of small sweeps for handling grass for hay and ensilage.

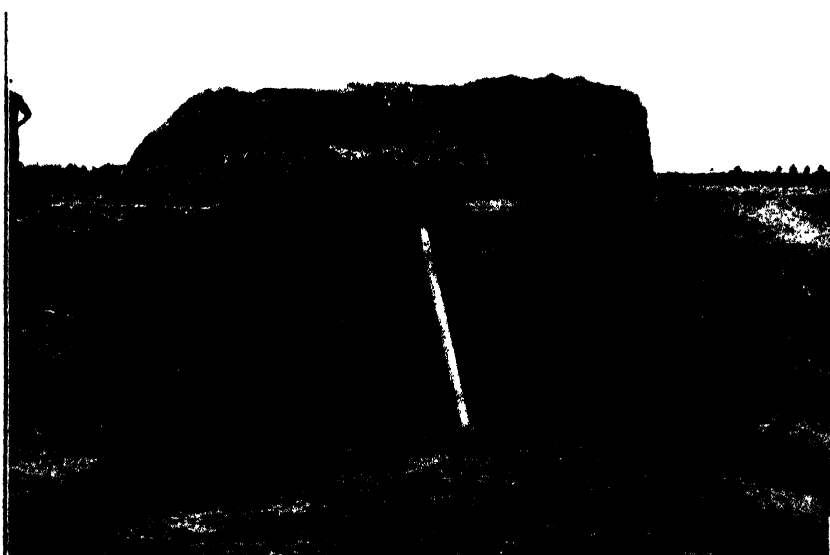


FIG. 16. A PARTIALLY COMPLETED PIT OF GRASS ENSILAGE.

The bulk of the supplementary feed for periods of grass-shortage is saved as hay and silage from permanent pastures, and for the 1933–34 season 190,972 acres were saved for hay and 53,235 acres for silage in the North and South Auckland Land Districts. [Photos by H. Drake.

necessity. Wintering is not considered payable, but it is not always possible to arrange littering just when required. (A farmer writes me as follows: "I attempt to get all the sows coming in just before the cows, but in the past eight years only once have I managed it without delayed or some dead litters.") All-grass dairying and root and cereal crops for pig-wintering is a somewhat difficult combination. The Bay of Plenty farmer is solving it with a rotation of swedes and maize: dairy-farms which provide winter roots for cows can winter pigs on roots and meat-meal, but many all-grass dairy-farmers seem to think it more profitable to lose somewhat on pigs and omit all annual cropping. Farm-management is, of course, always a compromise: net income rather than gross income is the test of efficiency.

REFERENCES.

(30) Rocks of the Cape Colville Peninsula, N.Z. Professor Sollas, F.R.S., Vol. I, page 29.
(31) Report of New Zealand Dairy Industry Commission, page 17
(32) Report of New Zealand Dairy Industry Commission, page 191.

DISTEMPER IN DOGS.

E. L. SIDDALL, Veterinarian, Department of Agriculture, Christchurch.

DISTEMPER in dogs is said to have been introduced to Europe about the middle of the eighteenth century and since that time has gradually spread throughout the world.

True distemper was considered to be found only in dogs or the dog tribe, but within recent years the important observation was made that ferrets are affected by it. Some investigators believed that cats could contract the disease from dogs, or might even convey it to dogs, but the disease from which cats sometimes suffer and which is so like dog distemper in its symptoms is due to a different virus and dogs are not affected by it.

Distemper is a contagious febrile affection generally attacking young dogs three to twelve months old. The parts most commonly affected are the mucous membranes of the eyes and nose, the lungs, stomach and intestines, and the nervous system. Cases have occasionally been noticed in old dogs. One attack of the disease confers immunity, even though the attack has been so slight as to be hardly noticed.

The disease is caused by an ultra-visible and filterable virus which is present in the blood and discharges, and dogs which are debilitated on account of improper feeding, underfeeding, long journeys, bad housing in damp draughty kennels, parasitism, or some disease such as rickets are especially liable to be affected seriously by it should they be exposed to the infection.

Associated with the virus are organisms which are responsible for the secondary lesions. For example, *Brucella bronchisepticus* is the usual cause of distemper pneumonia, and *Escherischia coli*, of which there are many varieties, is commonly held responsible for the alimentary troubles which may occur. These organisms are normally present in the healthy dog, but become virulent in the presence of the virus, and by the debilitated condition of the patient which it induces.

Collecting dogs in communities, such as fox-hound kennels, grey-hound-racing kennels, dog-shows, and, as in this country, dog trials is very often the cause of an outbreak of this disease. The virus is unable to retain its vitality for any length of time outside the animal body, but it is readily transferred from one animal to another. It is easily killed by disinfectants which should be freely used when an outbreak has occurred.

SYMPTOMS.

In the early stages of the disease dullness and loss of appetite are noticed. Temperature rises as much as three or four degrees or more above normal (which is approximately 101° to 101·6° F.). Fever is a very early and prominent symptom. There is discharge from the eyes and nose, which is at first watery but afterwards becomes thicker and eventually, unless frequently removed, closes these parts entirely.

The secondary symptoms show themselves in the form of eye lesions, bronchitis, pneumonia, and inflammation of the stomach and bowels. When bronchitis commences there is a cough, which is at first soft and afterwards hard, dry, and painful, and accompanied by wheezy breathing. If pneumonia supervenes the patient has spasms of painful coughing, which after a time are suppressed as much as possible, and at the same time the breathing becomes very distressed. The discharge from the nostrils is increased in amount and is often blood-stained, and finally the weakness and depression become very marked. If the stomach and intestines become involved there is loss of appetite and great thirst. The animal drinks a large quantity of water which often is soon vomited. When lying down the dog chooses a cold place, such as a piece of oil-cloth or a stony floor. There is a very unpleasant odour noticeable when the mouth is opened and inspected, and the tongue is found to be very furry, and finally blood-stained diarrhœa is seen. Involvement of the brain is shown by periods of excitement followed by convulsions and fits. These symptoms of brain-trouble are generally followed by paralysis, which may affect either one limb or half the body. Instead of this paralysis, a twitching of various groups of muscles may be noticed, causing such movements as champing the jaws or a jerky movement of the head, neck, or limbs.

TREATMENT.

As this is a disease which must run its course, very careful nursing, assisted by medicine, will give the best results. When the dog is first seen to be off colour it is essential for it to be isolated at once, for preference in a dry warm room which can be kept at an even temperature, with plenty of fresh air but free from draughts. The first treatment for the high temperature is to give aspirin twice daily, estimating the dose at ¼ grain per pound of body-weight. Any signs of constipation should be corrected with medicinal liquid paraffin in doses of a teaspoonful to a tablespoonful twice daily according to size, until the medicine has operated. Without doubt the best diet at this time is fresh milk. Improper feeding with meat and other solid material is very injurious and often accounts for serious complications. Lack of appetite, together with high temperature, is an indication to give only as much as the patient will take voluntarily in the form of milk. Forced feeding is injurious and often causes vomiting. When total loss of appetite persists for several days a few spoonfuls of milk, or liquid meat-extract, should be given every four hours, and to this may be added a few drops of

brandy. After the temperature, which should be taken twice daily, has dropped to normal, and the animal has a good appetite, boiled bread and milk, or boiled rice and milk, may be given. When the patient is put on to a solid diet only small and repeated quantities of easily-digested food are to be given.

The eyes and nose should be kept clean by sponging with warm water in which boracic acid has been dissolved, and afterwards they should be smeared with vaseline or boracic ointment. If the cough be troublesome a few doses of the following mixture should be given: Syrup of squills, syrup of ipecacuana, syrup of chloral, of each 3 drams; liquid acid carbol twenty-four drops, water to 3 oz. The dose is a teaspoonful, dessert, or tablespoonful, according to size of the animal, every few hours. When the cough becomes hard, dry, and painful, inhalation of steam medicated with eucalyptus or Friar's balsam is beneficial. Cover the chest with a woollen jacket to assist in preventing any further complications arising, such as pneumonia, which generally ends fatally in spite of all treatment. Vomiting can be treated by giving a mixture of bismuth carbonate, or bismuth subnitrate, in 5 to 10 gr. doses, together with a similar quantity of bi-carbonate of soda, two or three times a day.

A word of caution is necessary to the dog-owner to be careful to distinguish the early symptoms of distemper from the idea that the animal is suffering from worms, as many dogs have been killed through the indiscriminate use of worm medicines in the early stages of distemper. In distemper the temperature is raised, but this is not usually so in a case of worm-infestation.

After recovery from an attack of distemper it is important to remember that the dog should be treated with great care or else, in many cases, a relapse will occur. For a week to ten days after all symptoms have apparently subsided the food and exercise should be limited and only increased very gradually.

Vaccine for the prevention of this disease has been used with great success in England and elsewhere for some years past, but is exceedingly difficult and costly to prepare. Efforts to obtain supplies from England for use in New Zealand have failed until recently, owing to the vaccine deteriorating during the long journey out. This difficulty has now been overcome, and it is expected that this very valuable means of preventing distemper will be available to New Zealand dog-owners almost immediately. Supplies will probably be limited for a time, but no doubt will increase as the demand for it grows.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 18th June, 1936, to 30th July, 1936, include the following of agricultural interest: —

No. 74646: Milking-machine pulsator; T. A. Rowe. No. 74665: Preserving fruit; W. J. H. Hinricks. No 75654: Milk-product; Milk Processes Inc. No. 76029: Horse-shoe; T. S. Andrews and W. G. McDowell. No. 74576: Teat-cups; T. Shiels. No. 74578: Weed-killing; D. B. Lloyd. No. 74757: Log-splitting; W. Stubbs. No. 74899: Cream-can lid; W. Harvey. No. 76120: Separator; Aktiebolaget Separator. No 76125: Fertilizer-distributor; G. H. Baucke. No. 74130: Hay-stacker; T. H. Lawn. No. 74471: Nozzle for flame-thrower; J. McL. Donald. No. 74812: Manure-distributor; L. D. Chambers.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

BROWN-HEART (MOTTLED-HEART) IN SWEDES.

REPORT ON FIELD TRIALS WITH BORAX.

Fields Division.

THE disease known as brown-heart or mottled-heart of swedes has been prevalent in New Zealand for many years, more particularly in Westland, where during the past fifteen years it has become increasingly troublesome. In this district a certain amount of control has been obtained by the use of wood ashes, and many clean crops have been grown following such treatment. Mr. R. McGillivray, Fields Superintendent, Christchurch, reports, however, that the influence of wood ashes does not appear to be so effective in Westland as it was ten years ago, and a recent inspection disclosed a high percentage infection of brown-heart on some crops where ashes had been used.

Neill(1) on his return from Europe stated that a disease similar to the one known as "mottled-heart" was prevalent in Europe and Canada under the name of brown-heart, and that satisfactory control was being obtained by the use of boron compounds. Subsequently there appeared numerous reports of experiments conducted overseas in which borax and other compounds of boron were shown to be effective in the control of the disease. Hill and Grant(2), working in Canada, showed definitely, by means of water cultures and chemical analyses of diseased roots, that there was an inverse relationship between the amount of boron supplied and the occurrence of the disease, and that the latter was associated with low boron content of the roots. O'Brien and Dennis(3 ; 4) reported success in the control of brown-heart (known in Scotland as "raan") by the use of borax under actual field conditions.

In order to ascertain whether similar control methods could be adopted in New Zealand, field-work was commenced by this Division in the spring of 1935, and experiments were laid down on sixteen farms in various parts of the Dominion.

SYMPTOMS OF BROWN-HEART.

The symptoms of the disease are described by Mr. Neill as follows :—

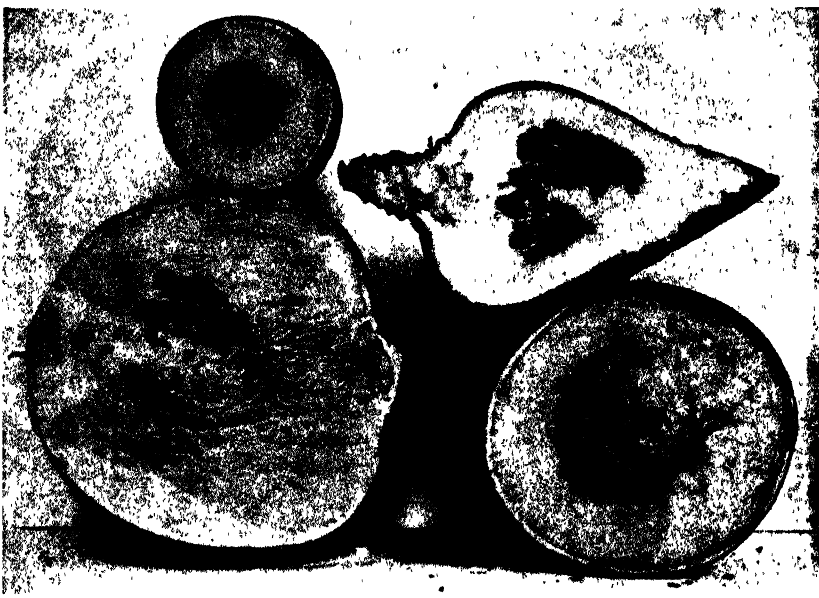
"Swede plants show no outward indication of the presence of brown-heart, but, when cut, irregular brown areas of tissue are seen grouped about the central axis of affected bulbs. This brown tissue has a somewhat water-soaked appearance, and is tough and bitter when eaten. Affected bulbs are consumed, apparently normally, by stock. When cooked they become hard and tasteless.

"Analyses carried out in Scotland(3) showed an increase of 2 per cent. in fibre and a decrease of 3 per cent. to 4 per cent. in soluble carbohydrates in affected swedes. In general, affected bulbs appear to keep normally, but in certain localities, especially the West Coast of the South Island, the affected tissues become invaded by rotting organisms resulting in early and rapid soft rot."

Sections of infected roots are shown in the figure on following page.

Methods used in Trials.

The treatment consisted of mixing 10 lb. per acre of commercial borax with sufficient fertilizer to sow an acre. The treated area was compared with the farmer's crop alongside treated with the same fertilizer, but which had not received borax. A wide range of fertilizers, both in kind and quantity, was used by the various farmers and the method of sowing varied from the 14 in. rows usual in the North Island to the 26 in. ridged drills common in Southland. Under the latter method portion of the fertilizer and borax was in contact with the seed, while part was sown below the seed.



SWEDES AFFECTED WITH BROWN-HEART.

The top right-hand swede is a white-fleshed bronze top; the remainder are yellow-fleshed swedes.

Effect on Germination or "Strike."

In three experiments a detrimental effect on germination was noted from the use of borax, while in one experiment, in Central Otago, the germination appeared normal until the crop was in the three-leaved stage, when about 50 per cent. of the borax-treated seedlings turned brown and died.

In four other trials there was a slight reduction in the number of plants on the treated area.

In Experiment 4 counts were taken of bulbs present in the mature crop, there being an average of thirty-eight present per half-chain on the borax-treated area as compared with forty-eight on the control, a decrease of 20 per cent. The control area was thinned in the usual way, but the borax plot did not require thinning.

EFFECT OF BORAX ON BROWN-HEART.

The following table shows that in the majority of trials satisfactory control of the disease was obtained by the use of borax. Details of methods of sowing and germination injury (if any) are also given.

Table I.—Effect of Borax mixed with Fertilizer (at various Quantities) on Germination and Control of Brown-heart.

Location of Trial.	Method of Sowing.	Amount of Borax and Fertilizer per Acre sown.	Effect of Borax on Germination.	Incidence of Brown-heart.	
				On Borax-treated Plot.	On Control Plot.
				Per Cent.	Per Cent.
1. W. Southland	14 in. drills	10 lb - 1⅓ cwt	Detrimental	Nil	Nil
2. W. Southland	26 in. ridges	7½ lb - 1½ cwt	Slight ..	Nil	80
3. E. Southland	26 in. ridges	10 lb - 3 cwt	Detrimental	48*	81
4. E. Southland	26 in. ridges	10 lb - 3½ cwt	Detrimental	36	63·4
5. S. Otago ..	26 in. ridges	10 lb - 2 cwt.	Nil ..	Nil	Nil
6. C. Otago ..	14 in. drills	10 lb. - 2 cwt	50% seedling mortality	Nil	95
7. Westland ..	28 in drills	10 lb - 4 cwt	Retarded ..	Nil	100
8. Westland ..	28 in. drills	10 lb - 3 cwt	Nil ..	Nil	100
9 Westland ..	28 in. drills	10 lb - 2 cwt	Nil ..	Nil	100
10. Poverty Bay	14 in. drills	10 lb. - 2 cwt.	Slight ..	Trace	10–20
11. Poverty Bay	14 in drills	10 lb. - 2 cwt	Nil ..	10–30	70–80
12 Taranaki ..	14 in. drills	10 lb - 5 cwt.	Nil ..	Nil	Nil
13. Rotorua ..	14 in drills	10 lb - 3½ cwt	Nil ..	16	82
14 Rotorua ..	14 in drills	10 lb. - 2½ cwt	Nil ..	Trace	Much
15. Waikato ..	14 in drills	10 lb. - 3 cwt	Slight .	2	20
16. Waikato ..	26 in ridges	10 lb - 2¼ cwt	Nil ..	Nil	Nil

* Only slightly affected.

In six trials complete control of brown-heart was obtained from the use of borax, while in six other trials the disease was considerably reduced. In the remainder of the experiments no brown-heart was noted. In view of the statements of O'Brien and Dennis(4) to the effect that heavy applications of lime tend to increase the susceptibility of swede crops to brown-heart it is of interest to record that in Trial 4 where the least control was obtained from the use of borax, the land was dressed with carbonate of lime at 2½ tons per acre before the swede crop was sown.

PROPERTIES OF BORON.

Boron never occurs free as an element, but in combination usually as boracic (boric) acid and in several minerals, such as crude borax or tincal, boracite, boronatrocalcite, hydroboracite, colemanite, rhodizite, sassolite, and botyrolite. As an element it is generally distributed throughout the earth's crust. Certain countries—*e.g.*, California, Germany, Persia, Tibet, Bolivia, China, Argentine, and Chile—have commercial deposits of importance.

Minute quantities of boron compounds are found in mineral waters, sea water, in plant shoots and ashes, and in animal and vegetable products. It is also present in minor quantities in the soil. In human and animal tissues it is most easily detected in hair, bones, liver, and muscles.

In plant nutrition a small amount is necessary for the health and growth of plants. Boron belongs to the group of minor elements of plant nutrition. In large amounts it is severely toxic to most forms of vegetation. However, there seems to be some evidence that below a certain limit of concentration boron exercises a favourable influence on plant-growth, encouraging the formation of stronger roots and shoots.

There does not appear to be any evidence yet that the amount of boron contained in plants making normal growth is insufficient for the needs of animals. When introduced in small quantities into the stomach of animals it is apparently not assimilated, but is thrown out in the urine and other secretions.

Boron is used at present in industry only in the combined state as boracic acid or as borates such as borax ($Na_2B_4O_7.10\ H_2O$). Borax (sodium borate*) is prepared from either boracic acid or from some of the crude minerals, such as boronatrocalcite, mentioned above, by treatment with washing-soda. At Searles Lake, in California, large tonnages annually of borax and potash fertilizer salts are separated by selective crystallization from other soluble substances from the same lake brine.

In the thermal region of Tuscany, Italy, large quantities of borax have long been made from boric acid recovered from natural steam springs or fumeroles and artificial well borings in the ground.

A few of the main properties of borax are: It is a white crystalline solid which is readily soluble in water; when heated it loses its associated water of crystallization and passes into a fused glassy mass. It is available commercially in a highly pure state of refinement in powder or crystal form. It forms two types of crystals according to the temperature at which it is crystallized out of solution.

In the household borax is valuable as a mild, alkali antiseptic and for cleaning clothes, dishes, &c. It softens water, neutralizes acids, and has many industrial applications—*e.g.*, in glazing, enamelling, and in manufacture of glass, soldering, soapmaking, dressing leather, preserving wood, &c. It is also used as a food preservative where its use is permitted by law.

In the extension of its use to agriculture the relatively small quantities required will no doubt be provided at comparatively low cost.

METHODS OF APPLYING BORAX.

In addition to the trials described above, four farmers in Westland used borax on portion of their crop, and the Fields Instructor, Greymouth, had an opportunity of inspecting these and estimating the incidence of brown-heart. In three cases no brown-heart was seen in the borax-treated area, whereas the control areas were badly affected. No control of the disease was in evidence on the fourth farm, and both borax treatment and an area dressed with wood ashes alongside were badly affected. One of the successful farmers applied the borax broadcast when the swedes were through the ground, and this is on a parallel with a similar instance in Britain recorded by O'Brien and Dennis(4). Mr. W. Alexander, Field Adviser, Messrs. Kempthorne, Prosser, and

* Also given in chemical literature as sodium pyroborate, sodium tetraborate, and sodium-bi-borate.

Co., Ltd., Auckland, states that at Galatea, where some trials were conducted by the Lands and Survey Department, good control of brown-heart was obtained from applications of 4 lb. borax per acre.

Recommendations made in Britain in regard to the control of brown-heart are for a dressing of 20 lb. of borax per acre to be applied *broadcast over the land just prior to sowing.* In order to get even distribution the borax is well mixed with a spreader, such as dry sand, although it is emphasized that the mixing process should be thoroughly carried out and any lumps crushed prior to mixing. This method of *broadcasting* the material is advocated for market-gardeners and farmers in New Zealand provided that the above precautions are taken. In view of the possibility of germination injury the amount of borax applied should be reduced considerably *when the material is applied with fertilizer,* and when it is realized that drilling in 28 in. rows means a concentration of borax probably seven or eight times that of a similar quantity applied broadcast it becomes evident that the rate of application should not be more than 8 lb. per acre, and that thorough mixing of the borax with the fertilizer should be carried out. If the drill is of the ridger type about half the material should be sown with the seed and about half below the seed.

PREPARATION OF "BORATED" FERTILIZERS.

In view of the necessary registration under the Fertilizers Act of special fertilizers containing boron, and taking into consideration the danger of germination injury from the use of excessive quantities of borax, it was agreed at a meeting of those interested that "borated" fertilizers should be registered provided they conform to the following specifications :-

(1) That the boron used in the mixture be in the form of sodium-bi-borate or any other approved source of boron ;

(2) That the percentage of sodium-bi-borate (or its equivalent) in the mixture be not greater than at the rate of 2½ lb. per 100 lb. of fertilizer ;

(3) That no free lime or any incompatible ingredients be used in the borated mixture ;

(4) That the borax used in the fertilizer mixture be finely ground and adequately mixed so as to ensure even distribution when applied to the crop ;

(5) That the advocacy of more than 3 cwt. per acre of a borated fertilizer be discountenanced when such fertilizer is being drilled in immediate contact with the seed ;

(6) That all bags be marked with the words "Borated mixture for Brown-heart" in addition to the usual brand.

SUMMARY.

(1) Experiments were carried out in the 1935–36 season on sixteen farms to investigate the effect of borax on control of brown-heart, the treatment consisting of mixing 10 lb. per acre of commercial borax with fertilizer and comparing this with the farmer's crop alongside which received no borax.

(2) In six trials complete control of brown-heart was obtained from the use of borax ; in a further six trials the incidence of the disease was considerably reduced, while no brown-heart was apparent in either plot in four experiments.

(3) Borax had an adverse effect on the " strike " in four experiments, and due emphasis must be given to the toxicity of the material when applied under certain conditions.

(4) It is suggested that an effective method of supplying borax is to broadcast 20 lb. of material mixed with fine dry sand before sowing the crop. If the material is to be applied with fertilizer and sown with the seed the quantity should not be more than 8 lb. per acre, and in the case of special fertilizer mixtures for turnips the content of borax should not be greater than 2½ per cent.

(5) Since lime applications appear to be incompatible with brown-heart control, such fertilizer mixtures should not contain free lime, and in districts where brown-heart is prevalent liming immediately prior to sowing a swede crop is not recommended for the above reason. This recommendation does not preclude the use of a properly reverted superphosphate in which no free lime is present.

ACKNOWLEDGMENTS.

The field-work in connection with the trials described above was carried out by Instructors in the various districts shown in Table I under the direction of Fields Superintendents at Auckland, Palmerston North, Christchurch, and Dunedin respectively. Thanks are extended to the farmers who co-operated in carrying out the experiments, to Mr. J. C. Neill, of the Mycological Laboratory, for his suggestions and assistance, and to Mr. J. A. Bruce, Inspector of Fertilizers, for notes in regard to the properties of boron.

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—*J. W. Woodcock, Crop Experimentalist.*

PASPALUM STAGGERS.

C. S. M. HOPKIRK, Veterinary Laboratory, Department of Agriculture, Wallaceville.

IN April, 1935, reports came to hand from North Auckland and from the Waikato that cattle were becoming affected with a form of staggering when grazing on seeding paspalum. The summer had been dry, but feed came away in excessive amount in the early autumn following warm rains. Previous to the nervous derangement in cattle, complaints were made by all having anything to do with paspalum that a sticky fungus which was becoming attached to clothes was present on the seed-head. This fungus was identified as being a species of Fusarium, *F. culmorum*, by the Government Mycologist. Later, at the time of the cattle disturbance, the brown, berry-like fungus known as *Claviceps paspali* was seen in abundance on ripe seed-heads and identified both by Dr. K. M. Curtis, of Cawthron Institute, and Dr. D. G. Steyn, of Onderstepoort, South Africa. From observations over a second season there is some doubt that the sticky stage of fungus growth was all Fusarium, for microscopically much of it appeared to simulate the honey-dew stage of the ergot. It is understood from the Seed Analyst, Mr. N. R. Foy, that in previous seasons there has been no sign of ergotized seed from New Zealand pastures, yet by 1936 all stands of paspalum were visibly affected all over the North Island.

The symptoms were noticed mainly in cattle, but did appear in a few horses. Cows and bullocks developed a trembling of the body, and if moved showed definite ataxia. The action was a jerky one, with definite inco-ordination of movement. Were the animals frightened so that they attempted to run, the inco-ordinated movement resulted in the animals falling over in curious attitudes. Some clonic convulsions were also noticeable at this stage. Once down the cattle lay for a short while, then scrambled to their feet and repeated the performance.

When the animals were left alone, the trembling was not marked: the animals fed and chewed the cud and were able to move forward slowly without any noticeable inco-ordination.

Animals taken off this type of pasture or fed on hay quickly recovered, and no mortality occurred except through accident. Therefore the action of the poisonous principle was apparently one affecting the nerve-muscle endings.

Blood-samples received for analysis showed nothing unusual.

A small amount of the affected seed-head was received at Wallaceville, and two guinea-pigs were fed on the dry, ground-up ergot sclerotia. One received 4 grams in eight days and the other 5½ grams. It seemed that the animals became "jerky" in movement during feeding, but they did not show trembling or any inco-ordination of movement.

During the past summer and autumn, thanks to the courtesy of Stock Inspectors, a large amount of paspalum infested-seed-head still on the stalk was obtained. Roughly, 10 per cent. of the weight was made up of ergot. The stalks and heads were dried so that no other moulds were present in excess, and the seed-head and stalk was fed

FIG. 1. PASPALUM STAGGERS
Heifer showing results of attempting to run

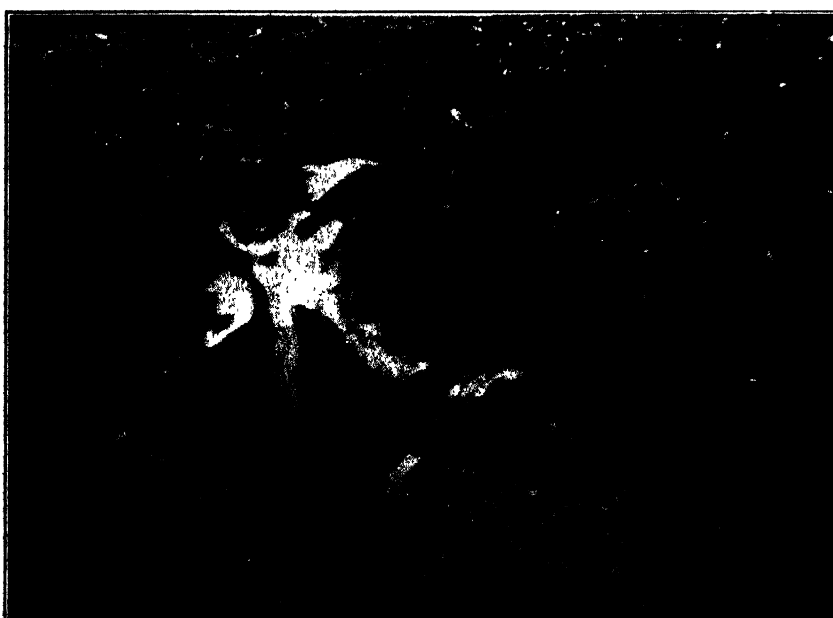

FIG. 2. SIMILAR TO FIG. 1.

to two heifers. They received about 2½ lb. gross each per day in hay for eight days. On the sixth day both were noticed to be trembling slightly, and on the seventh day were inclined to sway and tremble, but otherwise appeared to eat well and to be in good health. One animal was slightly worse than the other. On the eighth day the two animals were let out for a forced run. Both showed typical staggers, trembling, and severe ataxia to such an extent that they were unable to run, and fell in extremely awkward attitudes. Feeding was discontinued, and when put out on grass the two animals were entirely recovered clinically by the fifth day. No ulceration of the mouth nor any damage to the alimentary tract occurred judging from close examination and from consistency of fæces and lack of blood-stained mucus covering stools.

A second feeding experiment was undertaken by Mr. L. W. N. Fitch, who sieved off the ergot sclerotia and fed that forcibly and daily to a yearling heifer and to a cow with a calf at foot. He gave 10 oz. of pure ergot to the cow, but without any clinical results, and twenty-one ounces over eight days to the heifer. After the fourth day this heifer showed twitching and, later, violent trembling of the muscles of the body with salivation. On the ninth day she was inclined to stumble, but no true ataxia or clonic convulsion occurred, nor was lameness in evidence.

The heifer was killed on the ninth day. The alimentary tract showed a congested mucosa, but no other lesions could be found. As some looseness of fæces was noticed during the feeding, no doubt it was due to congestion of the mucosa.

During this experiment there was no change in the blood calcium, phosphorus, and magnesium, so that nervous symptoms were not due to a depletion of calcium or magnesium.

Discussion.

There seems some reason to think, therefore, that the typical symptoms of paspalum staggers appear when the young growing stage of ergot is present in the seed-head and that the full-grown sclerotia give slightly different and not such pronounced symptoms of nervous dyscontrol. Seddon, also, in Australia has been able to produce only the trembling symptom with screened paspalum ergot sclerotia, so that one would think there was some difference between the stalk-fed material and the screened.

Rye ergot (*Claviceps purpurea*) has been worked upon by chemists and pharmacologists for thirty years in the effort to find alkaloids and amines having some action on the body. It is probable that little difference exists in the chemistry of the two species *C. purpurea* and *C. paspali*. New Zealand rye ergot has been found to produce 0·34 per cent. alkaloid. Those named alkaloids known up till last year were ergotoxine(1) and ergotamine, which are active, and ergotinine and ergotaminine, which are inactive. The amines were tyramine, histamine, isoamylamine, and acetylcholine, all of which may only be bacterial breakdown products of protein. Last year ergotmetrine(2) was found—a water soluble alkaloid which has the beneficial action required for obstetrical purposes without the production of gangrene due to the contraction of arterioles.

The two main actions of ergot are production of (*a*) gangrene of extremities, and (*b*) nervous disorders.

Gangrene results from interference by occlusion of the blood-supply of the extremities, and with it extravasation of blood into the stomach and bowel may occur. The action is seen with prolonged use of ergotoxine and ergotamine

Where nervous disorders occur there is interference with the sympathetic nerve system at the myo-neural junction. Small doses of ergot stimulate, but large doses paralyse the motor junction, but, unlike epinephrine, the inhibitory junctions are untouched. This results in ataxia. If serious poisoning occurs, the ataxia increases to clonic convulsion and, finally, paralysis of the respiratory centre.

In the experiment described with paspalum ergot, either insufficient ergot was given to produce gangrene or the alkaloid present was in a form more conducive to the nervous dysfunction.

It is of interest to look back on the work previously carried out in New Zealand with ergot of the rye type (*Claviceps purpurea*).

Gilruth(3) in 1905 tried to produce effects in cattle and sheep with a commercial sample of dried ergot sclerotia, but without any effect. A calf consumed 10½ lb. in forty-five days, and a sheep ate 1½ lb.

Reakes and Reid(4) in 1911 fed liquid extract of ergot without effect, 3¼ pints to one calf and 2 pints to a steer over three months.

Later, Reakes and Reid(5) in 1912 repeated feeding experiments with rye-grass and fescue-seed head in which ergot was very prevalent. Two to three pounds of seed head were given a day. Lameness developed after five weeks, and dry gangrene of the extremities resulted later.

In an effort to produce rye-grass staggers considerable quantities of ergot present in rye-grass-seed screenings were fed to sheep at Wallaceville by Hopkirk(6). No nervous lesions developed, but two of the sheep were killed by the gangrenous effect of the ergot. One had 40 grams of ergot over five days, showing ulceration of the abomasum. The second had 60 grams over six days, and died ten days later with ulceration of tongue and severe enteritis. The remaining two sheep, although dosed with very large amounts over a period of five months, continued normal. They received 500 grams each. Apparently ergot quickly loses its toxicity when kept in open sacks and there is considerable difference in effect on individual sheep.

SUMMARY.

Paspalum-seed head affected with *Claviceps paspali* when fed to cattle produced typical ataxia and clonic convulsions as seen in the field in "Paspalum staggers."

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THE DRY-DUSTING OF CEREALS.

FIELD TRIALS WITH "CERESAN NEW" AND "AGROSAN G."

Fields Division.

AN extensive series of field trials was carried out by the Fields Division with "Ceresan New," one of the organic mercury seed dusts, in the 1933–34 season. (J. C. NEILL: Field Trials with "Ceresan New," *N.Z. Journal of Agriculture*, May, 1934.)

Since that time the use of both "Ceresan" and "Agrosan G" has increased rapidly, and, in fact, the whole of the wheat and oats, amounting to nearly 2,000 bushels passing through one South Island store, was dressed last season with one or the other of these compounds, copper carbonate being entirely displaced. In addition, it is reported that many farmers are doing their own dry-dusting with "Ceresan" or "Agrosan," using machines on the lines of the one previously described in this *Journal*. (T. A. SELLWOOD: Dry-dusting of Cereals, *N.Z. Journal of Agriculture*, December, 1935.)

During the 1935–36 season further field trials were carried out with these two materials on wheat, oats, and barley in the chief cropping-areas of the Dominion in collaboration with Mr. J C. Neill, of the Mycological Laboratory. The results of detailed experiments conducted by the latter at Palmerston North have been published recently. (J. C. NEILL: Experiments with two Organic Mercury Seed Dusts, *N.Z. Journal of Agriculture*, April, 1936.) The methods followed in the field trials were along the lines of those previously adopted—*i.e.*, one or more bags of seed were treated with "Agrosan" or "Ceresan" at 2 oz. per bushel, and these were sown by the farmer on a defined area. In three trials replicated plots were sown in order to determine any yield differences, although in two of these "Agrosan" was not used.

RESULTS OF YIELD TRIALS.

1. *Trial on Oats at Winton Experimental Area.*—Date sown: 4th October, 1935. Date harvested: 1st February, 1936. Crop weighed on 13th February, 1936, for yield of chaff.

The yield of chaff from the formalin-treated seed was 39·6 cwt. per acre, whereas that from the "Ceresan-New"-treated seed was 42·5 cwt. per acre.

The difference of 2·9 cwt. in favour of "Ceresan" was not statistically significant. During growth no positive differences were observed, and both treatments were free from disease at harvest.

2. *Trial with Wheat on Farm of A. Craig, Greenfield.*—Date sown: 28th August, 1935. Crop harvested: February, 1936.

The plots were threshed separately and weighed by Mr. Craig, with the following results: Formalin-treated seed yielded 41·2 bushels per acre, while the "Ceresan-New"-treated seed yielded 50·4 bushels per acre.

The yields were not examined statistically, but the large difference of 9·2 bushels in favour of "Ceresan" is likely to be real, in view of the

consistent superiority of "Ceresan" as judged by observations before harvest. During growth the "Ceresan" plots appeared markedly superior in growth and vigour, and prior to harvest were at least 1 in. taller than the formalin plots.

3. *Trial with Wheat on Farm of J. G. Fiecken, Tai Tapu.*—Date sown: 29th August, 1935. Crop harvested: 12th February, 1936.

Germination counts were taken on the 4th October, 1935. The results were,—

Seed Treatment.	Germination Counts. Number of Plants per 10 ft. of Row.	Yield in Bushels per Acre.
Copper carbonate ..	81·3	38·4
"Ceresan"	87·0	39·6
"Agrosan"	85·9	40·1

Differences in yield were not statistically significant. The number of plants on both "Ceresan" and "Agrosan" is significantly greater than that on the copper-carbonate treatment.

RESULTS OF OBSERVATIONAL TRIALS.

In the remainder of the trials observations were made during the growing-period, and these are summarized in the following table:—

Performance of "Ceresan" and "Agrosan" as compared with other Seed Treatments.

Seed Treatment with which Dusts were compared.	Number of Trials.	"Braird."			Crops.		Smut.	
		Better.	Equal.	Worse.	Better.	Equal.	Better.	No smut.
Oats—								
No treatment ..	5	2	3	..	1	4	1	4
Formalin ..	8	3	4	1	2	6	1	7
Bluestone ..	1	..	..	1	..	1	..	1
Wheat—								
No treatment ..	2	1	1	..	2	..	1	1
Formalin ..	1	1	..	..	..	1	..	1
Copper carbonate..	3	2	1	..	1	2	..	3
Bluestone ..	5	4	1	..	3	2	..	5
Barley—								
Formalin ..	2	..	2	..	..	2	..	2

COMMENTS ON ABOVE TABLE.

The column headed "Braird" refers to the appearance of the crop at or within a few weeks of germination. Out of fourteen trials on oats the "Ceresan" and/or "Agrosan" gave earlier or thicker strike than the farmer's treatment in five trials, while in two experiments the reverse was recorded. On wheat the mercuric dusts were reported to give a better strike than the farmer's treatment in eight out of eleven trials.

Under the heading of "Crop," observations were made at about harvest, and where differences were recorded they were generally manifested in the crop being taller and thicker. In three crops of oats and six crops of wheat differences were in favour of "Ceresan" and/or "Agrosan."

Observations on both loose and covered smut of oats, covered smut of barley, and stinking smut of wheat are included in the column headed 'Smut." Plots treated with "Agrosan" or "Ceresan" were all completely free from smut, while in three of the control plots smut was reported as being present. In one trial on wheat the difference in disease and crop was extremely marked, and the yields from "Agrosan" and "Ceresan" plots were estimated to be at least 15 bushels per acre more than the yield of untreated areas alongside, which was considerably reduced by incidence of both rust and smut.

No differences in braird, crop, or incidence of smut were noted in two experiments on barley.

No attempt has been made to record the performance of "Agrosan" and "Ceresan" separately in the above table. In three trials, however, "Ceresan" was judged to be superior to "Agrosan" in thickness of germination, and in two of these this difference was apparent at a later stage of crop development, although "Agrosan" was nevertheless considered to be better than control. In one trial the "Agrosan" area germinated more quickly than the "Ceresan" one.

SUMMARY.

Three yield trials and twenty-seven observational trials were carried out with organic mercury dusts—namely, "Agrosan" and "Ceresan"—on seed of wheat, oats, and barley. The results tend to support field trials previously conducted with "Ceresan," and also detailed experiments conducted with both materials by Neill in the present season, and which indicate that these materials are at least as effective in controlling smut as any of the older methods. There is often an added advantage in that the mercury dusts frequently assist field germination, and this is reflected in an improved yield.

In one of the yield experiments (which did not include "Agrosan") "Ceresan" gave an increase of 9·2 bushels per acre. In the two other yield trials no statistically significant differences in yield were obtained, although, in one of these, significant increases in field germination were obtained from both "Ceresan" and "Agrosan."

There are indications that farmers, particularly in the South Island, are rapidly changing over to these dusts in preference to wet "pickles," and even copper carbonate is being superseded.

The field work of the experiments reported above was carried out by officers of the Fields Division in the various cereal-growing districts throughout the Dominion.

The thanks of the Department are extended to those farmers who co-operated in carrying out the trials, and also to Messrs. Fassett and Johnson, Ltd., and Messrs. Campbell Bros., who donated the "Ceresan" and "Agrosan" respectively.

—J. W. Woodcock, Crop Experimentalist.

SEASONAL NOTES.

THE FARM.

Pasture Establishment.

UNDER a wide range of conditions pasture seed-mixtures often may be suitably sown in September. To obtain the fullest possible assurance of success, several matters require careful attention. Failures partial or complete in the establishment of pasture arise commonly because of—

(1) *Sowing when it is too cold—i.e.*, too early in the spring or too late in the autumn—sowing at an unsuitable date is a fruitful cause of poor results in clover establishment, and, in general, pastures poor in clovers are poor pastures. Certainly at times volunteer clovers repair to some extent the weakness due to the failure of the seed which was sown by the farmer, but in any case there is usually a delay in the functioning of the volunteer clover, and, further, and probably of greater importance, the volunteer clover may be of a strain much inferior to that selected for sowing because of its known inherent valuable characters. This is particularly the case when certified clover-seed is included in the mixture.

(2) *Sowing on poorly prepared seed-bed*, which may occur readily in the spring, especially should the cultivation be carried out when the soil is too wet for good results from tillage. Coarseness and lack of consolidation in the soil are the two common major weaknesses in seed-beds for pastures. When the soil is in what is commonly called a "lumpy" condition as distinct from one in which the soil has been "well worked down," it is clearly impracticable to carry out any process of covering the seed which does not necessarily result in a portion of the seed being covered too deeply. Some of the valuable kinds of pasture-seed are so fine that the depth of covering may not be particularly great and yet be too great, having regard to the small size of the seeds. The value of consolidation in seed-beds for pastures often is exemplified by the superiority of the "strikes" obtained where additional consolidation has taken place through the passage of stock or machinery.

Sowing on poor seed-beds frequently results in poor "strikes" of clovers, and the undesirable consequences of poverty of clovers have at times been so remarkable that farmers have sought for official information about what was considered to be an attack of disease, but which actually was merely poor thrift in the sward arising primarily from the absence of clovers.

(3) *The use of inferior seed.*—Seed may be poor because of its low germination capacity or its unsatisfactory purity; seed may be good in respect to purity and germination capacity and yet remarkably poor because it lacks inherited strain-characters desirable for the purpose in view.

Importance of Strain Characteristics.

Both the outstanding importance of the use of suitable strains of pasture-plants and the marked superiority of certain strains over other strains of the same species that are in commerce have become so very widely known during recent years that there now is much less need to direct attention to the economic importance of strain differences within the one species of pasture-plant. But although many farmers insist on obtaining seeds of known superior strain-characters, the fact remains that much seed of inferior strain is produced annually, and the bulk of it is used in New Zealand, while some of the seed of good strain is being exported. The position would be ludicrous if it were not so lamentable, and

from it one cannot form a particularly complimentary opinion of those farmers who use inferior strains of pasture-plants, when their real need is for the superior strains, and when they are not compelled to resort to the inferior strains the use of which is not economic.

The practical application of our present knowledge of strain differences in species of pasture-plants is to use certified seed when this is available. The species of major importance are perennial rye-grass and white clover; red clover and cocksfoot are species of considerable importance, and Italian rye-grass, which has come under certification only in relatively recent times, is of value in the sowing of temporary pastures. In view of the usual greater cost of lines of certified seed, it should be remembered that the use of inferior strains in the establishment of permanent pastures is almost certain to lead to a long period of avoidable depressed production of the pasture or to its unnecessarily early breaking-up and resowing. When this is borne in mind the use of the more expensive superior strains of seed will be seen in its true status as real economy rather than as extravagance. In practice the different classes of certified seed of any of the species is of some importance. full particulars about this may be obtained from local officers of the Fields Division.

Seed-mixtures.

The pasture seed-mixtures used by different farmers for the same set of conditions and the same ultimate purpose—*i.e.*, the establishment of a pasture to remain at the highest possible production for as long as possible—often vary a great deal in their constitution. Obviously two seed-mixtures which vary greatly in the content of species that are of basic importance are not likely to be equally suitable. It would be far from true to say that any definite finality has been reached in regard to the optimum composition of pasture seed-mixtures for conditions for which it commonly is necessary to prescribe. Nevertheless, a considerable amount of knowledge has been gained of mixtures which do or do not give good results (although maybe not the best results possible) under certain conditions On the basis of this knowledge certain seed-mixtures which may almost be called "standard" mixtures have been drawn up. These are mixtures which have been used extensively in recent years with relatively good results. The composition of the principal mixtures of this type is given in these notes in the February, 1936, *Journal*, and further information about these mixtures and other mixtures which may be more valuable for specific conditions is obtainable from local officers of the Fields Division.

As a rule permanent pastures are established most successfully when sown without companion crops, which somewhat misleadingly at times are called "nurse" crops: if the companion crops are heavy vigorous ones they are more likely to weaken the young pastures by over-shading rather than to assist them. When companion crops are deemed advisable their injurious competition may be lessened by the use of lighter seedings, and when the companion crops are cereals the period of competition should usually be shortened by harvesting the cereal for silage or chaff.

General Work with Pastures.

Often with advantage the feeding-out of hay, silage, and roots may be concentrated on fields on which ravages of the grass-grub are in evidence. The trampling and the additional fertility induced by the feeding-out seem of value in assisting injured plants on which there are vestiges of roots to recover more readily. Further, the feeding-out of hay, especially that in which there are viable seeds of valuable species, may result in a certain amount of useful surface-sowing. When the bulk of the valuable species in a pasture has already been destroyed, it is advisable to put the land under the plough, to be followed eventually by resowing. A pasture or

cereal cannot safely be sown immediately after a pasture or cereal which was attacked by the grass-grub—a sufficient number of the grubs is likely to be carried over, despite cultivation, to bring about serious reinfestation of the ground.

Grass-harrowing is likely to be much needed on those paddocks on dairy-farms on which stock have been held for winter-feeding. In particular, fields from which it is planned to harvest hay or silage during the coming summer should be harrowed thoroughly just before closing up.

Profitable results as a rule follow the application of phosphates to a pasture at the time of sowing or shortly afterwards. Such top-dressing tends to provide the seedlings with extra vigour, and this aids them in passing through the critical young stage.

Fields for Hay and Silage.

Fields intended for haymaking or ensilage should be closed up as soon as they can be spared from grazing. Early closing-up is valuable in that it favours the possibility of early mowing, which in its turn gives greater probability of a good aftermath which generally is very useful in the latter part of the summer. A top-dressing with superphosphate at closing-time is often advisable on fields for hay and silage, especially those not recently top-dressed.

September is often also a suitable time to close up lucerne areas: it assists in securing a comparatively early cut for ensilage, followed by a second cut before or about New Year. The general result of early closing of lucerne and the saving of the first cut as silage is an extra cut from the lucerne annually.

Seasonal Tillage.

A common cause of relatively poor crop-yields is the sowing of seed on land that has not received sufficient cultivation, and on many farms the only way to rectify this weakness is to miss no opportunity at this season of pushing on with tillage. Hence on most farms an extremely busy period is at hand, provided weather conditions permit of field work being carried out. But it should not be forgotten that more harm than good may result from working wet land: sandy soils may be worked with safety practically at any time, but great care must be taken not to work clayish soils while they are too wet. Sometimes it is possible to keep the implements at work by diverting them to old grassland when it is impossible to cultivate, without danger of injury, land which has been under cultivation for some time.

Provision of Special Feed.

One of the most important purposes of spring field work should be provision of adequate reserves of suitable feed for use during those periods when the feed directly available from pastures is less than the current requirements of the stock that any particular farm is able to support efficiently if its feed-supply is properly adjusted. The attaining of efficiency consists not simply in providing special reserves of feed adequate for the stock being carried, but adequate for the stock that can be carried if the feed-supply throughout the year is properly adjusted and utilized. Some farmers manage to carry on by providing only relatively small reserves of special feed and by tending to adjust stocking on the basis of minimum carrying - capacity. Such farmers do not exploit fully the productive capacity of their farms, and regularly are faced with surplus supplies of feed, especially in the summer, for which it is difficult to find economic use. Some sheep-farmers use the surplus feed by grazing cattle from which they receive little or no net return for the considerable amount of feed consumed. It may be granted that in some instances the use of cattle in this manner is unavoidable, but it does seem likely that cattle are at times used in this manner when such use could be avoided, and when greater net returns

could be obtained from the farm as a whole had the summer supply of feed been balanced by greater supplies at other periods made available by the creating of special reserves of feed. Enough has been said to indicate a farm-management problem of considerable importance. Two main questions arise. Firstly, should the seasonal supply of feed be adjusted so as to give the most effective possible use of the whole supply of feed produced on the farm, or, secondly, should the stocking of the farm be adjusted so as to avoid the need of much provision of special feed and so as to result in a portion of the feed produced being consumed with negligible direct economic return? The position seems to be this: no answers capable of general application can be given to the problem because much depends upon the circumstances in individual cases. To accept an affirmative answer to the second question is to adopt the easier course of action. Probably the easier course is not the best economic course in all of the many instances in which it is adopted. This matter may opportunely be raised at this stage because cultivation for some of the crops most important in the provision of special feed should receive attention now at every suitable opportunity. For use in the winter, mangels, carrots, chou moellier, swedes, and turnips are all suitable. Except in the more severe and southern districts mangels give particularly good returns when they receive the benefit of high fertility and good cultivation They are extremely reliable, being practically free from attacks of any serious disease or pest; they can withstand dry periods relatively well, and when they receive suitable treatment their total yield of nutriment per acre is very high. Because of these facts they should be grown much more extensively than they are grown. When the farming is somewhat extensive, with the result that the good treatment desirable for mangels cannot be given readily, swedes and turnips often may suitably replace them. Chou moellier rightly has increased in popularity in recent times for use in good ground Its requirements are similar to those of the cabbage, and hence land intended for it should be naturally rich or should be enriched by the free use of manures. Chou moellier is very suitable when club-root infection is known or expected to be in the soil: chou moellier though not completely immune is very resistant to attacks of this serious disease. Chou moellier is also of particular value on ground that usually is so wet at the time of feeding-off as to make swedes not altogether suitable. Carrots are suited by free fertile soils, on which, as many Taranaki crops have demonstrated, really good yields can be obtained. Often it is advisable to grow more than one of these crops, so as to obtain a more prolonged supply of feed than a single crop would provide. For instance, chou moellier and carrots may serve usefully for feeding before mangels have become fully mature All the crops under consideration benefit from a good clean seed-bed and a cultivation subsequent to ploughing usually is valuable in providing a soil of good tilth.

Lucerne.

For the provision of special feed lucerne, which is of particular value, calls for consideration at this period. The outstanding merit of lucerne as a forage crop arises from a combination of characters including high yield, high nutritive value, reliability during critical seasons, low cost of production, and capacity to improve soils An acre of thriving lucerne readily may yield annually 25 tons of green forage equivalent to a yield of 6½ to 7 tons of hay. Green lucerne when utilized before it has become woody is rich and highly digestible, while well-saved lucerne hay, because of its high nutritive value, may be used suitably to supplement feeds which are somewhat inferior. Because of its deep root-system it is well able to withstand drought, and so is reliable during difficult summers in which many other crops are prone to fail. Deep, fertile, open, well-drained soils are best for lucerne. However, judging from considerable field experience in New Zealand, lucerne can be grown successfully on a wide range of soils providing

their drainage is good. Good surface drainage and good underdrainage are both necessary for success with lucerne over a series of years. Lucerne is not well fitted to battle against weeds in its early life. Hence it is often advisable to sow lucerne on land which has been in old pasture and which has been ploughed once only: this normally gives a seed-bed less infested with weed-seeds sufficiently close to the surface to germinate than does land which recently has been under the plough for some time. Perennial twitchy weeds are especially objectionable in lucerne areas.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Seasonal Spraying.

THE early sprays prior to the blossoming period are of vital importance for the control of fungoid diseases. Spraying pip-fruit trees at green-tip and stone-fruit trees at bud-movement is generally recognized as the correct procedure. This initial application is referred to as the "foundation" spray, and, under normal seasonal conditions, if omitted from the spray programme, makes it impossible to secure a clean crop. Orchardists generally are fully aware that fungoid diseases cannot be cured, but can be prevented, and, therefore, appreciate the necessity for applying sprays at the above periods as a cover on the trees before the spores of fungous diseases become established on the young fruits and foliage.

All appliances should be in good working-order, so that no time is lost when spraying actually commences. This means that the spraying-machine and appliances should be overhauled, and, where a stationary outfit has been installed, it is also necessary to see that the pipe-line and taps are all in good working-order. The hose and nozzles should also be checked over. In many instances it has meant to growers the difference between profit and loss to find a burst hose or choked nozzle just when the spraying has been about to commence. Many an orchardist has had a dirty crop of fruit owing to the fact that he has taken the risk of his outfit being in good order, only to find that when he was ready to commence spraying the whole of the outfit needed overhauling, and by the time the machine, hose, &c., had been put in order rain had set in and disease had become established before the necessary spray could be applied. It should be remembered that the wet weather which holds up the application of the sprays enables disease to become established.

It is necessary to be thorough when applying sprays to fruit-trees. Every portion of the surface of the tree from the highest to the lowest twig must be thoroughly wetted. It is false economy to rush through the job because it is unpleasant work. Some growers are inclined to endeavour to make 100 gallons cover the area for which 200 gallons of spray are required. It is better to have too much than insufficient coverage of spray material.

An application of Bordeaux mixture (5–4–50) at green-tip stage is recommended for the control of black-spot on apples and pears. To this may be added winter spraying oil (1–25), which will be found an effective control for red-mite and scale insects. Three weeks later lime sulphur (polysulphide content 15 per cent.) (1–80) should be applied. If powdery mildew was prevalent on the trees during the previous season, lime sulphur (1–25) can be substituted for the Bordeaux at green-tip, to be followed by lime sulphur (1–50) ten days later, and after a further interval of ten days lime sulphur (1–80) should be applied.

For the control of peach leaf-curl, shot-hole fungus, bladder-plum, and brown-rot, &c., on stone-fruit trees, a thorough application of Bordeaux mixture (5-4-50) when the buds begin to swell is recommended. This should be followed by lime sulphur (1-80) at the pink stage. For the successful control of peach leaf-curl it is important that this application should be made before the most advanced leaf-buds reach the green-tip stage. The terminals of all lateral growth should be thoroughly covered with spray.

Cultivation.

Good cultivation of the orchard is necessary, and if the annual ploughing has not already been done it is advisable to attend to it as soon as the soil is in a fit condition.

Where late autumn ploughing was done, the spring ploughing may be deferred for a short time, to enable the cover crop or grass and weeds to rot, otherwise if the second ploughing is commenced too soon the cover crop or other herbage will be turned to the surface and commence growing again. Cultivation around the base of the trees is too often neglected, and should be given greater attention. The soil around the trunk and fibrous roots will be benefited by this aeration. Undisturbed ground at the base of trees not only is a harbour for diseases and pests, but needs cultivation to assist the growth of beneficial bacteria in the soil. If this work is completed at an early date, it will not be a difficult matter to keep a free surface on the soil throughout the remainder of the season.

Manuring and Liming.

Growers are now beginning to realize that it is impossible to obtain good results every season without applying organic matter and fertilizers to the soil. It makes no difference whether the soil is rich or poor (with the exception of the matter of time); sooner or later plant-food that has been used up by producing fruit must be replaced. As soon as possible after these notes appear manure should be applied, to allow the spring rains to carry it down into the soil.

It is difficult to state definitely the exact amount of fertilizer which is required in individual orchards, but the following may be taken as a basis to work on in applying manures to bearing trees: Superphosphate, 2 lb.; sulphate of potash, 2 lb.; and sulphate of ammonia 1½ lb. per tree. Of course, this should be varied somewhat according to the growth and crop-yield of the tree. For instance, if a tree is making vigorous growth and not producing much fruit, the potash may be increased to 3 lb. and the ammonia decreased to 1 lb. per tree. Or, on the other hand, if a tree is stunted in growth and producing a large crop of small inferior fruit, the potash may be decreased to 1 lb. and the ammonia increased to 3 lb. or more per tree.

Liming of the land is also beneficial, and should not be neglected. The application of 1 ton of carbonate of lime per acre every two or three years should tend not only to improve the physical condition of the soil, but to make more plant-food available. In addition to this, it will be found to assist the growth of the beneficial bacteria which enrich the soil, and without which trees cannot produce satisfactory growth and crops.

—*B. G. Goodwin, Orchard Instructor, Christchurch.*

Citrus Notes.

The time for the heaviest pickings of the year is now at hand. In addition to lemons, New Zealand grapefruit (Poorman orange) and sweet oranges have to be dealt with, and these latter now are reaching a more mature condition for marketing for dessert purposes. There is evidence that New Zealand grapefruit is becoming increasingly popular

with the consuming public as a breakfast food. It is important, therefore, that growers make sure that fruit which is marketed for dessert purposes is in suitable condition (tree-ripened) for this purpose, otherwise sales may receive a setback. As regards picking, the points mentioned in the notes for June and July are of such importance that one would suggest that they be re-read at the present time. It is impossible for the citrus-grower to achieve success by any quick, easy method: on the contrary, as field observations verify, those who are making most progress to-day are the growers who are attending very carefully to all the numerous small details which in the aggregate give worth-while results.

During harvesting a careful analysis of the rejects at picking-time will enable one to detect weaknesses in the programme of work which has been followed, and these observations should be committed to paper so that they may be referred to during the coming year. For example, if a certain block of oranges is showing a large percentage of silvery russet due to thrips injury, with a consequent degrading of the fruit, a note for future guidance is useful. In addition to this, where only odd trees are infected, they should be marked by attaching a piece of rag or other material in a conspicuous place, so that these trees may receive the necessary attention at spraying-time. Where during picking operations it is found that much of the fruit on a particular tree has failed to attain satisfactory size, consideration should be given to the condition of the tree, and a decision arrived at as to whether special attention by way of renovation or manuring is required. These trees should also be marked distinctively, a good practice being to have different coloured tags to denote different requirements.

New Plantings.—New orchards or extensions to existing ones are still being planned in some districts, and, although it is somewhat early for planting, it is necessary that several details be considered now. The matter of varieties must be decided upon, and, if it has not been done already, the trees should be ordered without delay from a reliable nurseryman. Where it is possible, it is advisable for the grower to visit the nursery and inspect the trees offering before purchasing, as it is important for the success of the venture that healthy, good-type, vigorous stock be purchased. Price should be secondary to quality, as a pound or two extra spent now in obtaining thrifty trees should be worth much more in returns later.

The matter of the stock on which the trees are worked is of importance, although, unfortunately, there is not a great deal of data available on this point for New Zealand conditions. Many growers are unaware of the stock on which their trees are worked, and a point for new planters is that they should find out this before buying the trees. The choice of stock will be limited at present to that which the nurserymen have used for the raising of the trees. Those recommended just now are sweet orange (*Citrus sinensis*) or rough lemon (citronelle). Trees worked on the trifoliate orange (*Poncirus trifoliata*) undoubtedly produce fruit of excellent quality, but in most instances they are so dwarfed in size that the quality of the fruit does not compensate for the lack of quantity. This stock is particularly unsatisfactory on light sandy soils. However, as it is not feasible to deal with the requirements of the various districts in these general notes in reference to stocks and the varieties to plant, it is advisable for growers to consult the local Orchard Instructor for this particular advice.

Owing to the probability of over-production, further general plantings of lemons are not recommended, unless the demand can be increased very considerably in the future. Our present knowledge indicates that further plantings of sweet oranges and New Zealand grapefruit are warranted. The latter does well in all of the citrus districts, and should be included in any new plantings. The sweet orange, however, should be confined to the warmer localities of the northern districts of the Dominion. The varieties

from which a selection may be made are—Hamlin's Early, Washington Navel, Jaffa, Best's Seedless (improved strain), St. Michael, Pineapple, Ruby Blood, and Late Valencia.

Some growers have planted out considerable numbers of trees of Marsh's Seedless (American grapefruit), but a word of warning should be sounded against indiscriminate planting of this variety, as reports on existing trees in New Zealand, even on those up to ten years old, show that the fruit produced is thick-skinned, pithy, and lacking in juice. Until further evidence as to its suitability is forthcoming, planting of this variety should be confined to small experimental lines.

The preparation of the land for new orchards should have been commenced long ago. It is essential that it be in good mellow condition before planting. If the area is infested with couch-grass, the trees should not be planted out until the ground is cleaned up. Similarly with regard to shelter, on no account should citrus trees be planted until this has been provided. If it is desired to take delivery of trees this year so that twelve months' growth may not be lost while the ground is being cleaned up, they may be planted in nursery rows about 3 ft apart and 2 ft. between trees. The small area occupied by the nursery must be well cleaned up and cultivated by hand hoe and the trees sheltered by scrim or brushwood where necessary. The following year, if the land is ready, the holes should be prepared, the trees lifted carefully with the roots intact, placed on a sledge a few at a time, transported to their new positions, and planted without undue delay in their permanent positions Under this treatment they should commence growth without noticeable setback

Manuring.—It is now time to consider the matter of fertilizers for the grove. If possible, organic matter, such as cover crops, farmyard, sheep, fowl, and well-conditioned fish manure, &c , should be turned in annually. As a source of nitrogen, sulphate of ammonia is the cheapest concentrated form, and it has been found that of all the fertilizing elements nitrogen is one of the most important If sulphate of ammonia is used, carbonate of lime at the rate of one and a half times the amount of the former should be applied as well, to correct the acidity created by the ammonia Nitrate of soda may be substituted for sulphate of ammonia Blood and bone and well-matured fish manure of good quality are approved citrus fertilizers, while superphosphate and potash should also be applied Where blood and bone is used a dressing of up to 20 lb per mature tree should be applied in the month of August ; or, if artificial fertilizers are used, 6 lb. of superphosphate and sulphate of ammonia plus 3 lb of potash, either sulphate or muriate, and 9 lb of carbonate of lime may be put on broadcast over the ground between the trees Young trees should receive a dressing applied about the tree in a small circular band, which is gradually increased in size each year, until the whole area is covered The quantity in the case of trees just planted should be small, say, 1 lb of the above mixture, progressively working up to the full quantity Manures, particularly those of the farmyard kind, should not be placed in contact with the trunk of citrus trees, owing to their liability to cause diseases of the bark. It is a good plan to vary the type of fertilizer used from year to year, provided that the main requirements mentioned above viz , organic matter and nitrogen—are not overlooked

Although cultivation of existing groves and the planting of citrus trees should be dealt with in the spring, due consideration should be given to the climatic conditions which usually prevail in the particular district which concerns the grower ; and, where cold snaps are likely to occur well into September, it will be as well not to accelerate these operations, especially in those districts where the spring rainfall is adequate In the following notes, which appear on 20th of September, these matters will be dealt with more fully in them.

—*A. R. Grainger, Orchard Instructor, Tauranga.*

POULTRY-KEEPING.

Egg-export.

DURING the spring of 1923 three shipments of eggs were exported from New Zealand to London. These were the first shipments of any size from this country, and they were made more or less as an experiment to ascertain whether our fresh eggs could be successfully landed in London and sold at a profitable price. As is well known, the eggs arrived in good condition and created a very favourable impression on that market, and practically every spring since eggs have been exported.

During last season some 11,915 cases (357,350 dozen) of eggs were shipped to the United Kingdom, the provincial totals being—Auckland, 78,300 dozen; Wellington, 5,730 dozen; Canterbury, 190,980 dozen; and Otago, 82,440 dozen.

Although this number represents only about 3 per cent. of the total number of eggs marketed in this Dominion, it is essential for the welfare of the industry that every effort be made to dispose of all our spring surplus, and also maintain the good reputation that New Zealand eggs have already made on the London markets.

Preparations are now being made for this season's export, and although individual poultry-keepers may consider that because their actual output is small, and they cannot export, the export business is no concern of theirs. This is quite a mistake. the export vitally concerns all producers as, although individually their output may not be large, the whole production goes to create the surplus which makes export necessary, and thus export is as much the concern of the small producer as the large, and all eggs should be forwarded in the most attractive manner.

The most desirable qualities in a good marketable egg are freshness, cleanliness, flavour, and size. As the eggs arrive at the export floor, they are unpacked on to trays and graded to size. Cracked, dirty, or mis-shaped eggs, or those too small, are rejected. All eggs are then individually tested before a strong light for freshness. The air-cell must not be more than $\frac{3}{16}$ in. in depth, contents must be stationary, white firm and clear, yolk dimly visible through shell, of good colour, and no process of putrefaction and no development of the ovum must have taken place.

Freshness.—It is doubtful if there is any other product where value depends more directly on freshness than an egg. When first laid an egg is practically full of liquid, but, as the shell is porous, the liquid gradually evaporates, leaving an air-space. Thus the older the egg the larger the air-cell becomes. Some egg-shells are more porous than others, and the more porous shells allow a more rapid evaporation to take place; nevertheless, the size of the air-cell is a good general guide as to the age of the egg, and if the air-cell is more than $\frac{3}{16}$ in. in depth such eggs are rejected for export.

This drying-down process is naturally more rapid during hot dry weather, or if eggs while being held for market are stored in warm or hot places. The keeping-quality of all eggs is affected if exposed to a temperature above 90 degrees. Fertile eggs deteriorate if exposed to a temperature of 70 degrees. Eggs actually are fresher after three weeks' storage in a cool, dry place than after a week in a temperature of 70 degrees. For these reasons, when eggs are being held before marketing, it is advisable to keep them in a cool, dry place.

Musty or Tainted Eggs.—Flavour is a very important factor in an egg, and one of the worst eggs a baker has to contend with is the musty egg, owing to the fact that one such egg is likely to destroy the

flavour of a whole cake mixture. Musty eggs, which are difficult to detect, may be caused by the feeding of musty grain or other foods. At times hens that have free access to pigsties or manure-heaps are apt to pick up unpleasantly flavoured food, and that taint may at times be transmitted to the egg. Again, musty eggs are often due to being laid on damp straw or nests, or being packed in damp, musty fillers; and also if allowed to stand in damp, musty fillers for forty-eight hours their flavour is likely to be affected.

Some hens lay an egg that may taste stale, but mustiness and undesirable flavours in eggs can usually be avoided by care and attention to details. Where good sound food is fed, plenty of good, clean, dry nesting-material provided, and if care is taken to see that eggs are collected regularly, stored in a dry cool place free from unpleasant odours, and sent to market in clean, dry cases and fillers, there should be little trouble from musty eggs.

Soiled Eggs.—Only absolutely clean eggs can be passed for export, and it is safe to say that more eggs have had to be rejected on account of the shells being more or less soiled than from any other cause. It has often been very disappointing to those at the grading-store to have to reject otherwise fine eggs on that account.

If clean nests were provided, say one to each four or five birds, and eggs were collected twice a day, especially in wet weather, much of this trouble would be avoided. In this connection, it is a good idea to have a tin, box, or spare nest covered up, and whenever the fowlhouse is visited to put the eggs laid into that receptacle to hold until the usual collections are made, thereby saving many eggs from becoming soiled because of hens walking over them. It is preferable that eggs for export should not be washed. However, when eggs become so soiled that they need washing, it is better to wash them in warm water as soon as they have been collected and before the animal heat leaves the eggs, as they are much less trouble to clean then. Washed eggs should never be placed in cardboard fillers until they are thoroughly dry. Badly stained eggs may be cleaned for table use by soaking them in a solution of 3 parts of water to 1 of vinegar.

Eggs having watery whites and tremulous air-cells have to be rejected, as such eggs dry down more rapidly. A great deal of investigational work has been carried out by workers all over the world, and by this Department, to ascertain the definite cause or causes of this defect. Authorities have mentioned several likely contributing causes, such as the physical condition of the hen, lack of or too much green food, insufficient animal food, or allowing eggs to get into a sweated condition. However, tests have shown that the method of packing has a big influence on the internal condition of many eggs, and, if packed with the large end down, this defect is likely to be produced. Better results are obtained when holding eggs for market, and especially when packing for transport to market, by taking care that all eggs are packed with the small end down.

Carriers.—Each season quite a number of more or less broken crates arrive at the grading-stores. Not only have many eggs been broken on this account, but other eggs have had to be rejected owing to their being soiled with the contents of the broken eggs. Where wire carriers are used, it is advisable to place strips of paper between the wires in order to save eggs from being badly marked by twisting around in the wires during transit.

Shell-texture.—The quality of the shell is another important factor in a good marketable egg. A strong smooth shell is most desired. Thin or rough, porous shells allow too much evaporation of the egg liquid, with the result that they dry down rapidly and are soon classed as second grade.

Again, thin-shelled eggs are more liable to get cracked or broken. Each season a large number of eggs has to be rejected on this account. A record kept of an average lot of 11,880 eggs showed that 514 eggs had to be rejected because the shells were cracked. By taking care when collecting eggs, and especially when packing them into fillers for market, a good deal of this loss could be avoided.

Size.—Shape and shell-quality can be improved by a careful selection of eggs for hatching purposes. Only 2 oz. eggs of good shape, texture, and colour should be set. The stock should be supplied with plenty of oyster-shell grit, and, if the shell-texture is generally poor, the addition of 1 per cent. of oyster-shell dust to the mash and a little burnt, broken bone for the birds to pick at should help.

The following is an analysis of two average good lots of eggs sent to be graded for export:—

		Per Cent.
Number recorded	54,420	
Packed for export	46,919, or	86.2
Rejected for being cracked	3,489, or	6.4
Rejected for being soiled	1,783, or	3.27
Large air-cells or watery whites	1,777, or	3.26
For bad shape, and too small	387, or	0.71
For blood spots	65, or	0.10

Owing to the enormous competition on the London market, and owing to the fact that New Zealand eggs have to travel a long distance before reaching the British consumer, every care must be taken to see that grade and quality are kept up. These defects have been pointed out in order to assist producers to reduce the great loss caused each year by thousands of eggs being spoiled by causes which, with a little care, could be prevented.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Breeding.

NORMALLY at this season of the year there are large patches of brood in the hives. A further examination may be carried out where the beekeeper was in doubt in the preceding month as to the hive being queenless or not. The absence of brood at this season denotes that the queen is poor or that the hive is queenless. In either case it is advisable to unite with another hive. This should be done immediately, as a queenless hive stands in great danger of being robbed by other bees in the apiary. A ready method of uniting is by placing the weak colony over a strong one on the stand of the latter, with a sheet of newspaper between the two hive-bodies. The colonies may be examined after a couple of days to see if things are going well, and if the paper is not bitten through it should be torn in several places. In another day or two the united colonies will be working peaceably. In the case of the weaker colony it is wise to kill the queen before uniting.

At this examination the beekeeper must keep a strict watch for symptoms of disease. If foul-brood is discovered in a mild form the colony should be marked for treatment later in the season. Should the colony be badly affected, however, it is advisable to sulphur the bees and destroy the combs. Care should be taken to remove the hive to a place of safety until it can be properly cleansed.

Overhauling the Hives.

In August a great deal of the preliminary seasonal work of the apiary may be done. Each hive should receive a good coat of paint. This will help to preserve the timber, besides giving the hives a neat appearance.

The bottom-boards should be scraped clean. During the winter months there is usually an accumulation of cappings, pollen, and dead bees, and this, if left, becomes a harbour for woodlice, which are very objectionable. A simple plan is to provide a spare bottom-board. Lift the hive on to the spare one, scrape the old board, and replace the hive. Remove all top boxes, and make the bees snug and warm for brood-rearing. Clean all weeds and long grass from round the hive. Long grass keeps the hives and bottom-boards damp, and acts as a harbour for insects.

Cleansing Hives and Frames.

The beekeeper should not fail to cleanse all hives and frames that have been in contact with diseased colonies. This work may be undertaken now, and the hives and frames prepared for future use. Where there is only a small number of frames to be cleansed it is hardly worth while to attempt to save them. However, if much material has to be treated the saving effected will more than pay the beekeeper for his time and labour. There are several methods for treating hives and material, but perhaps the simplest and most effective is by the use of boiling water and caustic soda. Many beekeepers recommend the use of a painter's blow-lamp, but this is not always handy, besides which the charring of the hives indicates for all time that they once contained diseased bees.

The most suitable vessel for cleansing frames is an ordinary washing-boiler. To every 8 gallons of water add 1 lb of caustic soda, and allow to boil. The frames may be tied in bundles of six and immersed in the liquid The caustic soda attacks the propolis and wax, and this immediately floats on top of the water. Three to five minutes' immersion serves to cleanse each bundle of frames. Skim the refuse from the top of the water frequently, and as the solution weakens add more soda Stack the frames in supers, and place in the sun to dry. The hive-bodies and bottom-boards may be cleansed by means of a swab. Immerse the swab in the boiling water and carefully wash the inside of the hives. Care must be taken when using caustic soda, as it is liable to burn the hands.

Robbing.

A strict watch should be kept for robbing. This is most likely to occur when feeding has to be undertaken, and once started it is about the hardest thing to cure. Feed only in the evening, so that the excitement created by the supply of warm syrup will have died down before morning Keep the entrances to all hives contracted, and see that there are no cracks through which a robber can possibly enter Perhaps the main cause of robbing is the presence in the apiary of queenless or weak colonies If the bees once discover a queenless hive there will be no peace until the source of the trouble is removed The inmates of such a hive do not defend their stores as do bees in a normal condition, and unless the colony is united with another it tends to demoralize the rest of the apiary, until none but strong colonies are safe from the depredations of the robbers

Where a weak colony is in danger of being attacked, and where the beekeeper is satisfied that it is worth saving—that is, when he considers the queen good enough to build up a strong colony by the time the main honey-flow sets in—his best plan is to pile wet grass on the alighting-board and well up above the entrance, keeping the grass wet for a day or two, and painting any cracks in the hive with kerosene or carbolic solution This treatment soon restores peace in the bee-yard. However, the best thing to do with the weak colonies is to unite them without delay with stronger hives. As in the case of most other troubles, however, prevention is the best thing when dealing with robbers. Do not spill any syrup near the hive, do not leave any combs lying about, and do not have any weak colonies, and you will not be troubled with robbing.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Lettuce Crops.

A NATIVE of Central Asia, the lettuce (*Lactuca sativa*) has been a popular salad crop from the dawn of history. It is in continuous demand at the present time, and possesses, among others, narcotic, anodyne, and sedative properties which are of value. It is generally used in a raw state for salads or garnishing ; but, when plentiful, it is excellent as a cooked vegetable.

Including the dwarf cabbage and tall cos lettuces, the red and the green leaved, black-seeded and white-seeded, there are about a hundred varieties in cultivation, and of these there are many strains. The cos is a fine-flavoured lettuce, but the general demand is for a crisp, green cabbage lettuce. The most popular variety of this class is known as Webb's Wonderful, otherwise as New York, Hercules, or Neapolitan, although the latter is often a strain of a rather heavier type. This variety is being grown here under glass and outside at all seasons, and for summer and autumn cropping is unlikely to be displaced ; but for winter and spring cropping here outside, or winter cropping under glass, there are in some instances more suitable varieties, especially for the cooler districts.

An effort has been made by Brian, of the Long Ashton Research Station, and others to classify the embarrassing number of lettuce varieties and their synonyms. It is work which is of great assistance to one who desires to make an intelligent selection. Brian has classified a number of leading varieties according to five of their main characteristics, but that characteristic which is most consistent is the cultural use of the variety. The list can almost entirely be divided into varieties suitable for growing under glass—forcing ; varieties suitable for growing outside during the winter—winter lettuce ; and summer lettuce. There are a few general-purpose varieties, chief among which are All-the-year-round, mainly sown in autumn or early spring outside or under glass in an unheated house ; and Trocadero, otherwise known as Big Boston, with red-edged leaves, which is grown in winter and spring, to which is closely related the green variety Market Favourite (Unrivalled), which is another variety grown outside at all seasons in cool climates.

For a winter crop under glass the varieties Cheshunt Early Giant, Golden Ball, Feltham King, and All-the-year-round are some of the most satisfactory.

For a winter crop outside a trial of seventy-six varieties was made at Wisley, England, by the Royal Horticultural Society in the year 1923, which practically confirmed the results of a similar trial held five years previously. The seeds were sown on 5th September (5th March, New Zealand), and transplanted on 29th September, " on ground in an open situation which had had a previous crop of broad beans. . . . a few plants died, and their places were filled on 31st October, after which no planting was done." A committee examined the growing crops on several occasions, and the following awards were made :—

(1) Winter Giant (Veitch) ; Stanstead Park (Nutting) ; Brittany Winter White (Barr) ; White Madeira (Barr).

(2) Hammersmith Hardy Green (Cullen ; Watkins and Simpson) ; Hardy Hammersmith (Dobbie) ; All-the-year-round (Simpson ; Watkins and Simpson ; Barr ; Dickson ; Toogood ; Dobbie).

(3) Hercules (Dobbie) ; Grand Admiral (Veitch) ; Winter Brown (Barr) ; Schofield's Hardy Winter (Barr) ; Reliance (Barr ; Watkins and Simpson) ; Early French Frame (Watkins and Simpson).

Of those receiving the highest award, Winter Giant and Stanstead Park are comparatively large with medium green leaves more or less tinted red. Brittany Winter White resembles Stanstead Park, but the leaves are a

paler green and not tinted. White Madeira is a large compact plant with firm head of good quality, tender—" a little-known but excellent hardy variety."

In the next class Hammersmith Hardy Green and Hardy Hammersmith are medium size, medium green colour without red tint (similar varieties are Hardy Winter Green, Immense Winter, Lee's Immense, Yates's Winter, and Hammersmith). All-the-year-round is rather large—medium green puckered leaves forms a fine heart of good flavour.

In the third class Hercules is similar to Webb's Wonderful, although that variety was entered and did not secure a place in the awards. Grand Admiral is a variety with red-tinted leaves, as is Winter Brown, which has a firm head somewhat bitter. Schofield's Hardy Winter is of medium size, has green leaves, and is a popular hardy variety. Reliance is a medium-sized plant with red-tinted leaves, and Early French Frame is a selection from Black-seeded Gotte, with yellowish-green foliage, small size, very compact, foliage somewhat blistered, head firm and of good quality.

All of these varieties of hardy winter lettuces to which awards have been given have, with the exception of Hercules, which is a " crisp " variety, leaves with a smooth surface with what is commonly referred to as a " buttery " texture. In the colder districts here especially, the varieties Brittany Winter White and White Madeira deserve a careful trial, while the variety All-the-year-round is worthy of more consideration under such conditions. Early French Frame is also outstanding in its class. There are a number of " strains " of these varieties in commerce, and it is important to take the greatest care to obtain the most suitable.

The cos lettuce, which derives its name from an island in the Greek Archipelago, originally known as Cos, is a very sweet, crisp, palatable salad plant, and, while not approved by the market, is well worth a place in the private garden. It was not conspicuous in the above-mentioned trials for winter cropping, neither is it so amenable to hot, dry situations as some cabbage varieties ; but under good conditions the tall lettuces of this class produce a heavy crop that is usually of excellent quality Paris White and Lobjoit's Green are popular varieties.

Other Vegetables.

In the colder localities early crops of globe beet, white turnips, short-horn carrots, parsnips, radishes, peas, onions, parsley, lettuce, cabbage, and cauliflower are still being sown. Elsewhere preparations are being made to plant main crops, to be closely followed by such half-hardy crops as French beans, marrows, corn, &c.

Crops sown during the month of September in most districts with a climate of average temperatures here are main crop potatoes, carrots, beet, spinach, and, where summer cabbage is difficult, silver beet ; also Brussels sprouts, celery, and leeks for planting out main crops early in the New Year or thereabouts.

Potatoes on the market have much improved since greater interest has been taken in the quality of the " seed " sown. This has led to an increased interest in the cooking, and as a result the potato is again resuming an important place on the menu. There is no more important axiom in cropping than the statement one cannot reap better produce than they sow. Speaking generally, fresh certified seed should be sown each year in the warmer districts ; elsewhere fresh stocks every two or three years may be satisfactory. For small areas where certified seed is not used table potatoes of good quality may be cut into pieces with one or two eyes each and planted without delay. The opportunity should be taken to examine the flesh of the tuber, and if any sign of disease or abnormal condition is present it should not be planted. If these precautions are observed and the principles of crop rotation are practised, there will usually be a creditable crop to harvest. On farms where this is a leading crop, the seed is sown with a mechanical planter or ploughed in : on smaller areas the ground

after harrowing down is scored with a marker to indicate the rows, and the seed is planted along the drills by means of a short-handled grubber. The use of a dibber is not generally recommended, as it is more difficult to control the depth of the planting. In the home garden planting is often done as the ground is being dug. Early crops are planted rather close, as they are usually dug before they ripen. For the main crop 15 in. to 18 in. between the sets and 28 in. between the rows is suitable for most varieties that are grown.

Good land newly broken in will produce a satisfactory crop without manures; but otherwise a dressing of fertilizers is necessary. In the absence of any well-established local practice a mixture composed of 3 parts superphosphate to one part sulphate of ammonia may be used at a rate of 4 cwt. or 5 cwt. to the acre; on heavy land this rate is sometimes doubled, in which case it will often be an advantage to replace a portion of the superphosphate with bonedust. On light soils the addition of 1 cwt. of sulphate of potash may be an advantage. Nitrogenous manures should be used with some caution, as a rank growth predisposes the crop to the attack of fungous blights. The fertilizer is drilled in before or at the time of planting: on small areas it may be used at a rate of 4 lb. to 100 plants, which is equal to 5 cwt. per acre. Specially important is it to harrow the ground two or three weeks after planting, before the plants are through the ground, to break up the surface crust and destroy seedling weeds. If this is repeated as necessary it will greatly reduce the labour of weeding and improve the tilth for moulding up

In warm districts a full supply of carrots and beet can be obtained by sowing early-maturing varieties in spring and autumn. But in colder localities an autumn crop of that kind is not satisfactory, and winter supplies are best obtained by sowing main crops of these roots towards the end of the month of September. Types with fairly long roots of good quality are most profitable. If sown earlier the long season of growth is inclined to make them coarse.

The tomato and other half-hardy crops sown recently and placed in a hot-bed should be pricked off, so soon as the plants are large enough to handle, into other boxes, spacing them about 2 in. apart The plants are handled by the leaves, as the slightest bruising of the stem at this tender stage of growth causes serious injury.

Where slugs or snails are troublesome it should be remembered that powdered bluestone or alum is a powerful destroyer of pests of this kind. Alum may be freely applied after sundown as a dry powder, or dissolved at a rate of ¼ lb. to ½ lb. to a gallon of water When dealing with large areas it is sometimes an advantage to mix the powdered alum with twice its weight of lime-hydrate before broadcasting the mixture very lightly. Bluestone finely ground is often mixed with kainit at the rate of 1 part to 20 and broadcasted at a rate of 1 oz. to the square yard; it should not be allowed to lie on the foliage.

The Homestead Garden.

Odd corners may be brightened by the expenditure of very little labour by sowing now hardy annuals in fairly large areas of each kind. Well-grown sweet peas, nasturtiums, mignonette, &c., are of a quality equal to some of the best.

Foliage pot plants about the house which require repotting may be given that attention during the month of September. A fresh loam with sufficient humus to retain water and sharp sand to keep it friable will give the best results. Until the plants are thoroughly re-established after potting they should be watered sparingly.

The bright vigorous condition which is so admirable in plants is very desirable in the lawn, which perhaps is the chief feature in the formation of an adequate setting for the brighter flowering plants and trees. To assist in getting rid of weeds and mosses and strengthen the grass, applications of sulphate of ammonia and sulphate of iron at intervals

during the spring and early summer are not to be excelled. Mix well 3 parts sulphate of ammonia, 1 part of powdered sulphate of iron, and 20 parts screened sand, and broadcast it over the lawn at the rate of 4 oz. to the square yard—repeating the application at intervals of one month. Where the condition of the lawn is poor, a stronger mixture made by reducing the sand ingredient by one-half may be tried.

—*W. C. Hyde, Horticulturist, Wellington.*

WEATHER RECORDS: JULY, 1936.

Dominion Meteorological Office.

NOTES FOR JULY.

JULY preserved the character of the preceding portion of this year for a prevalence of fine and mild weather interspersed with phenomena of record-breaking intensity. Though temperatures were below normal and hard frosts were numerous, especially in the North Island, stock and vegetation do not appear to have suffered to any extent. Stock, indeed, are almost everywhere reported to be in good condition, and ample feed is available. Vegetation seems to be further advanced than usual, there being signs of growth, particularly in the leaf-buds of trees. Spring flowers, also, are commencing to bloom. In heavy soils the ground is waterlogged and cultivation at a standstill. The cold spell which was setting in at the end of the month may prove to be the cause of some damage.

Rainfall.—In the North Island, though the rainfall was in general above average, there were numerous exceptions Thus, the Auckland Province, from Russell southward to Tauranga, received less than the normal amount. So also did parts of Taranaki and Hawke's Bay. In the South Island, Nelson and the West Coast had somewhat less than normal, but elsewhere the month was a very wet one Numbers of places in Otago had double the average fall Wet days were more numerous than usual, the only spell of settled weather occurring in the third week

Temperatures --Temperatures were everywhere below the normal for July. In western districts from Taranaki southwards the departures were generally only slight, but in most of the rest of the country they were somewhat over a degree The South Island experienced frosts in approximately the average number and intensity. In the North Island, however, from one end to the other they were unusually numerous and sharp. At this time of year and in the fine and relatively windless weather in which they occurred, they were responsible for little damage. There is a considerable amount of snow on the mountains

Sunshine —In general, the amount of sunshine did not differ greatly from the average, and there was no marked general trend in the departures. Of two places rather near each other, one would have rather more and one rather less than normal. Tauranga had 177·4 hours, Nelson 163·0, and Napier 158·8 hours

Pressure Systems.—The weather of the first week was very unsettled, with general rain on most days. Violent storms passed on the 3rd and on the morning of the 6th. On the 3rd there were westerly gales over the North Island and south-westerlies in the South. Snow fell to low levels on the ranges, and there were numerous hailstorms. Early on the morning of the 6th barometers at the Bluff and in the vicinity reached the record low level for New Zealand of 28·33 in. Though not so low elsewhere, the readings in many places transgressed all previous records. From the 5th to the 6th severe westerly gales were experienced in most parts of the country. The rain was heavy, and in a few places moderate flooding occurred. Numerous hail and sleet showers were again reported, with snow down to low levels on the hills.

After strong southerly winds on the 7th, which in places reached gale force, fine weather ruled in most places until the 16th.

Another rather severe storm approached from the Tasman Sea on the 16th, and by the 21st heavy rains had fallen everywhere. Northerly gales blew on the 18th and 19th about and north of Cook Strait. Otherwise, from the 19th till the end of the month, there was a strong prevalence of southerly winds.

On the 27th and following days heavy and general rains fell. On the 30th southerly gales set in and continued till the 1st August.

RAINFALLS FOR JULY, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
North Island.						
	In.		In.	In.	In.	In.
Kaitaia	6·44	21	1·55	5·48	34·46	33·64
Russell	6·84	17	2·16	5·27	64·11	32·60
Whangarei	4·64	21	1·28	7·19	41·50	38·79
Auckland	5·23	24	1·67	5·58	30·60	29·86
Hamilton	5·70	20	1·57	5·10	33·19	29·00
Rotorua	5·95	12	2·08	5·00	42·39	31·85
Kawhia	8·48	13	1·94	6·01	34·98	31·55
New Plymouth ..	6·32	21	1·34	6·38	34·58	34·92
Riversdale, Inglewood ..	9·68	22	3·00	10·06	55·41	58·71
Whangamomona ..	8·26	12	2·14	7·27	43·00	42·97
Hawera	4·32	16	0·97	4·22	26·94	25·61
Tairua	4·62	16	1·31	6·31	35·47	39·87
Tauranga	4·76	16	1·39	4·94	38·04	31·82
Maraehako Station, Opotiki	5·78	14	1·12	4·45	39·17	32·24
Gisborne	3·84	17	0·85	5·05	32·31	29·96
Taupo	5·13	18	1·58	3·87	31·42	25·23
Napier	4·05	17	1·04	3·27	37·64	19·35
Hastings	2·49	14	0·64	3·66	32·67	20·29
Whakarara Station ..	4·74	14	0·71	..	40·42	..
Taihape	4·05	25	0·68	2·97	30·00	20·78
Masterton	5·12	19	1·21	4·18	33·14	22·95
Patea	5·60	20	1·17	4·23	30·23	25·63
Wanganui	4·55	14	1·15	3·34	26·83	21·04
Foxton	3·59	17	0·60	3·11	24·24	18·38
Wellington	8·42	21	1·82	4·85	35·83	25·74
South Island.						
Westport	6·38	13	1·41	8·30	37·68	54·80
Greymouth	7·73	14	2·17	7·93	42·98	57·49
Hokitika	6·73	13	1·85	8·96	44·32	64·05
Ross	9·27	10	3·81	9·18	51·86	71·95
Arthurs Pass	11·37	7	4·93	9·93	60·32	85·87
Okuru, South Westland	8·64	7	2·75	10·52	72·31	82·56
Collingwood	9·13	14	1·75	9·40	48·90	54·96
Nelson	3·05	11	1·07	3·48	19·33	21·80
Spring Creek, Blenheim	3·82	14	1·40	3·42	21·32	17·89
Seddon	3·11	13	1·31	2·40	17·83	14·72
Hanmer Springs ..	7·92	20	1·49	4·29	37·26	26·06
Highfield, Waiau ..	3·69	18	0·80	3·34	26·98	20·08
Gore Bay	5·18	18	1·23	2·80	26·07	18·67
Christchurch	4·00	18	0·87	2·54	23·30	15·17
Timaru	3·03	11	0·76	1·84	21·10	12·98
Lambrook Station, Fairlie	2·63	13	0·61	2·62	18·01	14·60
Benmore Station, Clearburn	4·01	14	1·70	1·74	13·51	14·54
Oamaru	2·56	13	0·50	1·72	17·62	12·70
Queenstown	3·44	12	1·10	2·03	18·46	17·38
Clyde	1·37	11	0·31	0·90	8·04	8·66
Dunedin	6·74	18	1·15	2·98	27·93	21·06
Wendon	2·67	17	0·50	1·74	17·43	17·22
Balclutha	4·87	17	0·90	1·78	18·71	14·49
Invercargill	4·83	22	0·68	3·27	25·98	26·58
Puysegur Point ..	8·26	23	1·01	6·15	47·74	48·41

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BUTTER-BOXES AND MOULD-GROWTH.

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MOULD-GROWTH on the surface of stored butter is unattractive to the buyer and injurious to the butter. It has been shown by several investigators that mould fungi can grow well on the surface of both salted and unsalted butter, and Vernon(1) has demonstrated that they may develop in the interior of unsalted butter, although generally they are limited to the surface layer of salted butter. Surface mould seldom makes its appearance until stored butter has been defrosted. The origin and control of mould is therefore of great importance to manufacturers of butter, especially in countries (such as New Zealand and Australia) distant from their principal markets, because butter made over a considerable period may be affected before this happening becomes known to the makers.

The sources of infection have been variously attributed to butter-boxes, parchment, and aerial contamination of the butter during manufacture. Vernon(1) has shown that butter-box timber and parchment-paper can be the source of moulds and can support mould-growth. Neill(2) has confirmed Vernon's observations with regard to timber, and he has also shown that the treatment of timber with a solution of the sodium salt of salicylanilide, sold under the trade name of "Shirlan W. S." is effective in preventing mould-growth on butter-box timber.

The part played by butter-boxes is of great significance to the New Zealand butter industry. Three types of boxes—viz., standard, sub-standard, and sawn-timber Saranac (wire-bound)—are used for exporting butter. The design of each is defined in the New Zealand Dairy Regulations(3). Until recently Saranac boxes made of rotary-cut timber were also employed, but their export has been prohibited since 1st January, 1936. The first three named boxes are made of sawn timber, which may be either air-dried or kiln-dried. Rotary-cut timber differs radically from the sawn in two respects. Prior to peeling, the logs are subjected to a treatment with high-pressure steam which enables the knife to shear off the cut timber in "peelings" of any desired thickness. The peeled timber is then straightened by passing the pieces between hot rollers, being dried to a definite moisture content. The timber is next cut into required sizes and assembled into wire-bound boxes. The economy of this process by the elimination of saw-dust is obvious.

In addition to differing in design, the boxes differ in the thickness of timber employed in their construction. The ends of both the standard and sub-standard box are made of timber $\frac{5}{8}$ in. in thickness. The sides, top, and bottom of the standard are made of $\frac{1}{2}$ in. timber, while the corresponding parts of the sub-standard are made of $\frac{3}{8}$ in. The ends, sides, top, and bottom of the Saranac wire-bound box are made of $\frac{1}{4}$ in. timber.

White-pine timber is most extensively used, but silver-beech and Swedish pine, impregnated with wax, are also employed.

EXPERIMENTAL.

The following two series of experiments were carried out to determine (*a*) the relative resistance of different types of butter-boxes to mould-growth; (*b*) the effect of heavy infection of box-timber with mould spores; (*c*) the extent of damage caused by surface mould; and (*d*) the practicability of protecting butter from mould-growth originating from the box.

In the first series, objectives (*a*), (*b*), and (*c*) were studied. The second was undertaken to provide confirmatory evidence of the first and to test on a semi-commercial scale the effectiveness as a fungicide of Shirlan W. S.

Fifty-six-pound boxes of the various types under trial were packed with salted butter at a nearby butter-factory. They were then held in cold storage at 13° F. for nine days, and, after being defrosted in a room kept at an average temperature of 68° F. and from 85 per cent. to 90 per cent. relative humidity for a period of a week, were examined individually for mould-growth. Prior to being stacked for defrosting, each box was dropped several times from a height of about 3 ft. to the floor to simulate handling in transit. This treatment caused the sides of some of the boxes to "spring" from the ends. Care was taken in stacking the boxes to expose all types to approximately the same conditions.

FIRST SERIES.

Seventeen boxes were employed, five being standard, two sub-standard, five Saranac made of sawn timber, and five Saranac made of rotary-cut timber. Prior to being filled with butter, two of each of the standard, sawn Saranac, and rotary-cut Saranac types, and one sub-standard, were sprayed inside and outside with a mixed suspension of spores from pure cultures of *Pullaria pullulans*, *Cladosporium herbarum*, and *Penicillium expansum*, and thereafter lined with a double fold of 28/30 lb. parchment-paper. One standard, one sawn Saranac, and one rotary-cut Saranac were first similarly infected with mould spores and thereafter lined with parchment-paper, also sprayed with the same suspension of mould spores. The remaining boxes were not artificially infected.

The boxes were filled with salted butter, stored, defrosted, "dumped," and examined as described above.

RESULTS.

(*a*) *Non-infected Boxes.*—The standard and sub-standard boxes were free from visible mould-growth. Black-spot (*Cladosporium*) and green-mould (*Penicillium*) developed in scattered areas on the outside and inside of the sawn Saranac boxes, on the parchment lining, and on

parts of the surface of the butter. Internal mould-growth was most prolific at those points at which the sides had "sprung" from the cleats of the boxes.

The rotary-cut Saranac boxes showed much heavier mould-growth, the exterior, interior, and parchment-paper all being affected. A little mould penetrated to the surface of the butter. The predominating moulds were *Cladosporium*, *Penicillium*, *Mucor*, and a red staining type. As in the case of the sawn-timber box, mould-growth was most profuse in areas adjacent to openings between the sides and ends.

A significant feature of the mould on both types of Saranac box was its dense growth on panels made of soft, sappy timber, those made of heart timber being comparatively unaffected.

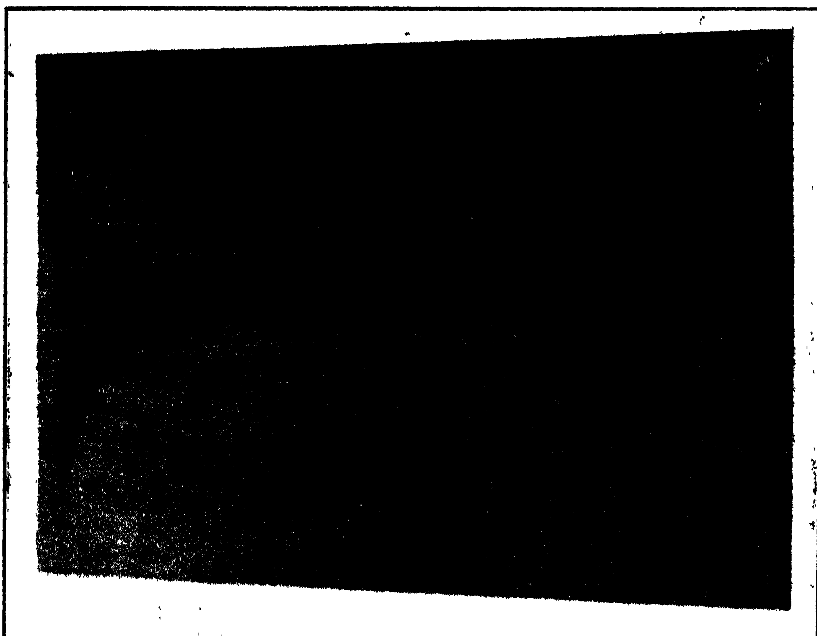

FIG. 1. INNER SURFACE OF SIDE OF SUB-STANDARD WHITE-PINE BOX, SHOWING MOULDING ADJACENT TO SEAM

[*Photo by H. J. Drake.*

(*b*) *Infected Boxes*.—As was to be expected, all of the inoculated boxes developed more mould-growth than the non-inoculated, the intensity of infection varying with the type of box. That on the standard and sub-standard was limited to areas adjoining seams (Fig. 1) in the sides of the box; no mould penetrated to the surface of the butter at these places. The sawn Saranac boxes showed more extensive growth of mould on the exterior and interior and on the parchment-paper, especially at the seams and edges. Some mould penetrated to the butter. The rotary-cut Saranac boxes were even more extensively

covered with moulds, as also was the surface of the butter. In all cases *Pullaria* predominated, but the *Cladosporium* and *Penicillium* were also present. Boxes lined with infected parchment developed no more mould than those not so treated. Furthermore, no mould developed from infected parchment under those parts of boxes not affected with mould-growth.

SECOND SERIES.

The same types of boxes were employed, with the addition of (*a*) standard and sub-standard boxes made of Swedish pine and (*b*) sawn Saranac boxes made of $\frac{3}{8}$ in. white-pine. Provision was also made to investigate the possibility of preventing the growth of mould on the boxes by treating them with a solution in water of sodium salicylanilide (Shirlan W. S.), and to determine whether a lining-material made of aluminium foil sandwiched between two sheets of parchment-paper would prevent mould from penetrating to the surface of butter from badly-infected timber. It has already been shown that this latter material prevents the development of surface yellow colour on butter by avoiding the evaporation of moisture(4).

In all there were used sixty boxes, treated as follows:—

Type of Box.	Non-infected		Artificially infected		
	Control.	Shirlan-treated	Untreated.	Shirlan-treated.	Untreated and packed with Foil-parchment
Standard white-pine ..	2	2	2	2	2
Sub-standard white-pine ..	2	2	2	2	2
Sawn Saranac white-pine ..	2	2	2	2	2
Rotary white-pine ..	2	2	2	2	2
Sawn Saranac $\frac{3}{8}$ in. white-pine	2	2	2	2	2
Standard Swedish pine ..	2	2	2	2	2
Sub-standard Swedish pine..	1	..	1	2	1

The ten Swedish pine standard boxes were impregnated with wax, while four of the sub-standard were not waxed. The Shirlan-treated boxes were immersed in 0·1 per cent. solution of Shirlan W. S. for ten minutes, the standard and sub-standard boxes being treated in the shook, and the Saranac type in the wire-bound but open state. Subsequent to treatment, the boxes were air-dried. The infected boxes were sprayed with a suspension of mould spores as in Series 1, the Shirlan-treated boxes being sprayed subsequent to treatment. The parchment was not sprayed. The boxes were packed with salted butter, stored, "dumped," and defrosted in the same way as the first series. As in Series 1, the sides of several of the $\frac{1}{4}$ in. Saranac boxes sprang from their ends whilst being "dumped." The $\frac{3}{8}$ in. Saranac boxes remained intact. Some of the standard and sub-standard boxes had split sides—see plates 2 to 4. There was no visible appearance of mould-growth on any of the boxes prior to storage nor on immediate removal from the cold store.

RESULTS.

The following table shows the relative extent of mould-growth observed in the various butter-boxes :—

TABULAR PRESENTATION OF RESULTS OF EXAMINATION OF BUTTER-BOXES.
(Degree of Visible Moulding indicated by Number of Crosses.)

Description.	Untreated Control.	Treated Shirlan.	Untreated inoculated.	Treated Shirlan inoculated.	Untreated inoculated packed Foil.
Standard white-pine ..	x	o	x	x	xxx
,, ..	x	o	xx	x	xx
Sub-standard white-pine ..	xx	o	x	x	xx
,, ..	xx	o	xx	x	xxx
Sawn Saranac ¼ in. white-pine	x	o	xxx	x	xxx
,,	xx	x	xxxx	x	xxx
Rotary-cut Saranac ¼ in white-pine	xxxx	o	xxxx	x	xxxxx
Ditto	xxxxx	xx	xxxx	xx	xxxxx
Sawn Saranac ⅜ in. white-pine	x	o	x	x	xx
,,	x	o	x	x	xx
Swedish standard waxed ..	o	o	x	o	x
,, ..	o	o	x	x	o
Swedish sub-standard waxed	o	..	o	o	o
,,	..	..	x	..	..

The non-infected standard (Fig. 2) and ⅜ in. Saranac (Fig. 4) white-pine boxes developed only a small amount of mould-growth which did no material damage to the butter. The sub-standard (Fig. 2) and ¼ in. sawn Saranac (Fig. 3) developed more extensive growth, which penetrated to the butter near openings in the boxes. In several cases more mould was observed inside the box than on the exterior. The untreated rotary-cut Saranac boxes were heavily covered with mould, and in the stack stood out clearly from the others (Figs. 3 and 4)

The untreated Swedish-timber boxes were quite free of mould-growth (Fig. 5). Infection of the timber with mould spores accentuated the degree of moulding in all cases previously affected and induced mould-growth on some of the Swedish boxes. The growth on the inoculated boxes was general, while that on the non-inoculated was localized (Fig. 7). The non-infected Shirlan-treated boxes were free from mould with the exception of a very little on two rotary-cut cases, those artificially infected following treatment showing a little more. Chemical examination of the surface of butter packed in Shirlan-treated boxes showed no evidence of salicylanilide. The foil-parchment was effective in preventing mould-growth from penetrating to the surface of the butter, even from the most heavily-infected boxes (Fig. 6). Extensive damage was caused to the surface of butter to which mould penetrated through the parchment from the interior surface of boxes (Fig. 7).

As in the first series of experiments, growth was most extensive in areas adjacent to openings in the box. In some cases profuse growth extended from openings caused by "sprung" ends of Saranac boxes and spread over the whole of the interior sides. It was again observed

in this series of experiments that boards taken from "heart" close-texture timbers were much less subject to mould-growth than those from sappy, soft-texture timber (Fig. 6). Whilst the Swedish-pine boxes were superior to those made of untreated white-pine in their resistance to mould-growth, they imparted a definitely undesirable wood taint to the surface of the butter.

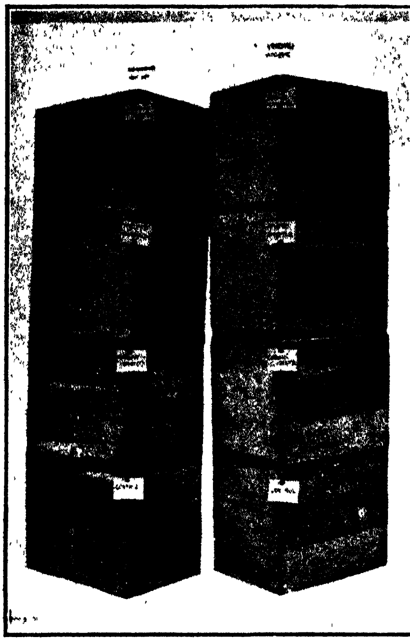

FIG. 2.

Left stack, sub-standard white-pine, right stack, standard white-pine Top tier of both stacks infected, treated Second tier of both stacks infected, untreated. Third tier of both stacks not infected, treated Bottom tier of both stacks not infected, untreated.

[*Photo by H. J Drake.*

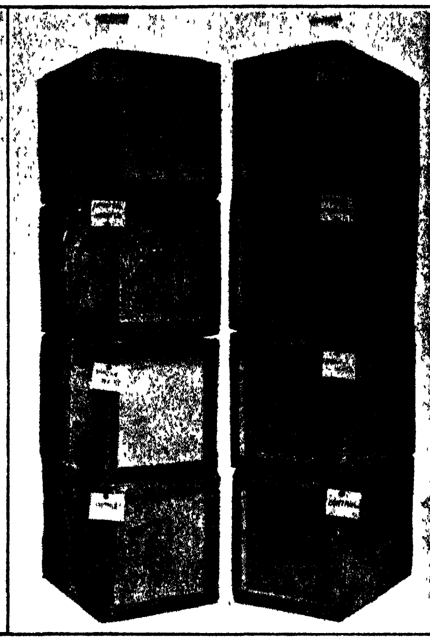

FIG 3.

Left stack, rotary-cut Saranac 1¼ in, right stack, sawn Saranac 1¼ in Top tier: Infected, treated Second tier Infected, untreated Third tier: Not infected, treated Bottom tier: Not infected, untreated.

[*Photo by H. J. Drake.*

DISCUSSION.

It has been clearly shown that butter-box timber is a source of mould-infection for stored butter. Whilst infected parchment is less important than infected timber as a source of mould, it is readily pierced by mycelium and consequently affords inadequate protection to butter from an infected container.

Butter that has been held in cold storage is very susceptible to infection from timber during the defrosting process. This is demonstrated by the facts that butter-boxes heavily infected with mould spores showed no growth of mould prior to and on immediate removal

from storage, whilst they developed profuse growth during defrosting. Thus trouble with mould in export butter is not likely to be observed till the butter has reached the retailer.

Because of the widespread occurrence of mould spores and the ease with which they are carried by wind, it is impossible to avoid spores on butter-box timber. Under normal defrosting conditions no trouble is experienced from a normal spore load. Yet excessive infection may cause trouble in any circumstances and, what is even more important, there are conditions under which mould-growth from normal spore

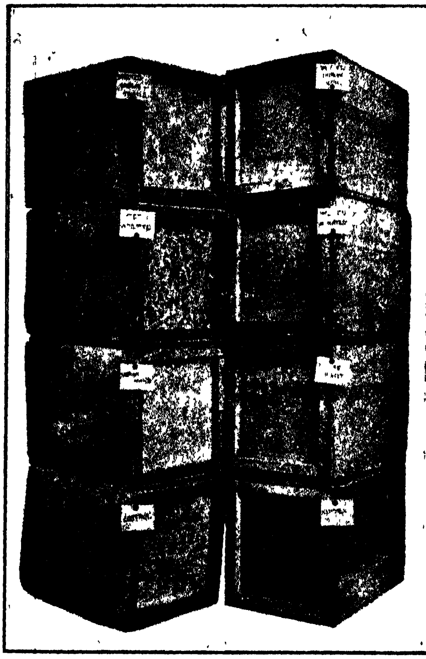

FIG. 4.

Left stack, rotary-cut $1\frac{1}{4}$ in. Saranac, right stack, sawn $\frac{3}{8}$ in. Saranac. Top tier: Infected, treated. Second tier: Infected, untreated. Third tier: Not infected, treated. Bottom tier. Not infected, untreated. [Photo by H. J. Drake.

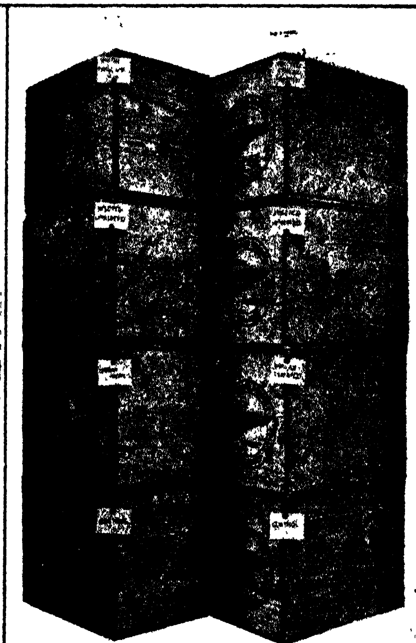

FIG. 5

Left stack, standard Swedish pine, right stack, sub-standard Swedish pine. Top tier: Infected, treated. Second tier: Infected, untreated. Third tier: Not infected, treated. Bottom tier: Not infected, untreated. [Photo by H. J. Drake.

load may be favoured. These conditions are (*a*) the deposition of free moisture on the inner surface of butter-boxes and on the lining parchment-paper; (*b*) the admission of air to the space between the butter-box and the parchment; and (*c*) the presence of readily available nutrient substances in certain types of timber.

The transference of butter from cold stores to chambers held at atmospheric temperatures naturally leads to the deposition of moisture on the boxes. This deposition is accentuated by high temperature, high humidity, close stacking, and lack of air circulation. Obviously

most trouble is likely to be experienced in summer months. Ideally, cold-stored butter should be defrosted in chambers that can be air-conditioned, but this is impracticable under commercial conditions, and, in any case, present losses do not warrant these precautions in temperate climates.

It is quite clear that the thickness of timber exercises a distinct influence, ½ in. white-pine timber developing less mould-growth than ¼ in. That this is not likely to be due to differences in the insulating property of the different thicknesses of timber has been shown by McDowall(5). The more likely explanation is the capacity of the thicker timber to absorb more moisture without becoming soaked. On

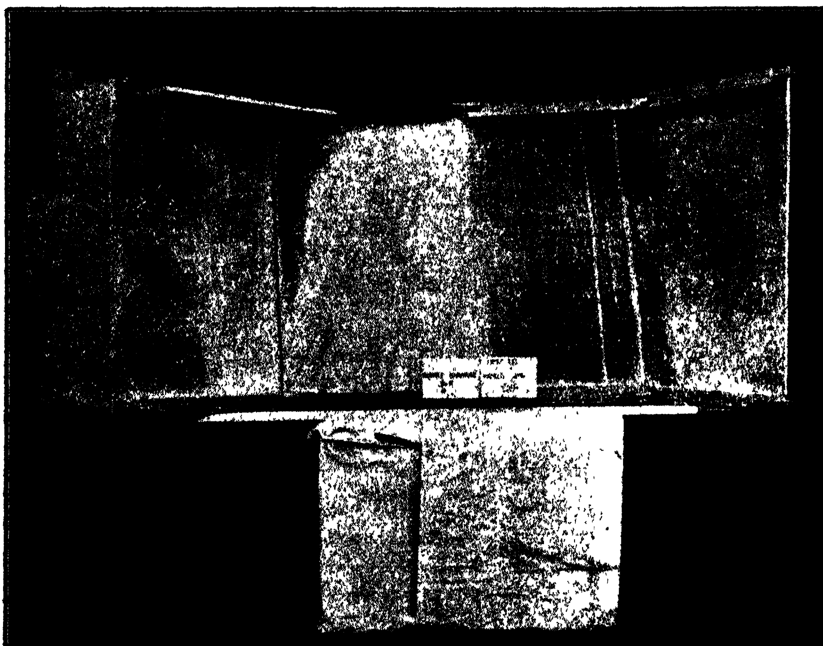

FIG. 6. ROTARY-CUT SARANAC, INFECTED, RESTING ON CONTAINED BUTTER PACKED WITH ALUMINIUM-FOIL PARCHMENT.

[*Photo by H. J. Drake.*

removal from a cold store the moisture content of butter-box timber is lower than when admitted to the store. This is illustrated by the fact that the wires on waxed boxes never became so loose as those on unwaxed. During the defrosting process the wood thus absorbs some of the dew as it is formed, and if it can do so at a rate commensurate with that at which the surplus collects there is not likely to be sufficient for mould spores to germinate. The thicker the timber the less free moisture may be expected to accumulate. This may therefore be the explanation of the benefit of using ½ in. or ⅜ in. instead of ¼ in. timber.

The admission of air apparently plays an even more important part. It is a significant fact that in these experiments mould-growth was

extremely profuse on the internal surface of boxes to which air was admitted through openings caused by staples springing from the junction of the sides and ends of the wire-bound boxes. This is probably due to heavy condensation of moisture on the cold surface of the parchment, where, being sheltered from air currents, it is not quickly evaporated. Thus absence of external mould is no guarantee of freedom from internal infection. This emphasizes the great need for so constructing boxes, by using additional staples, clinching their ends, or employing dovetailed pieces of timber, that the sides and ends will remain intact, even when submitted to rough handling.

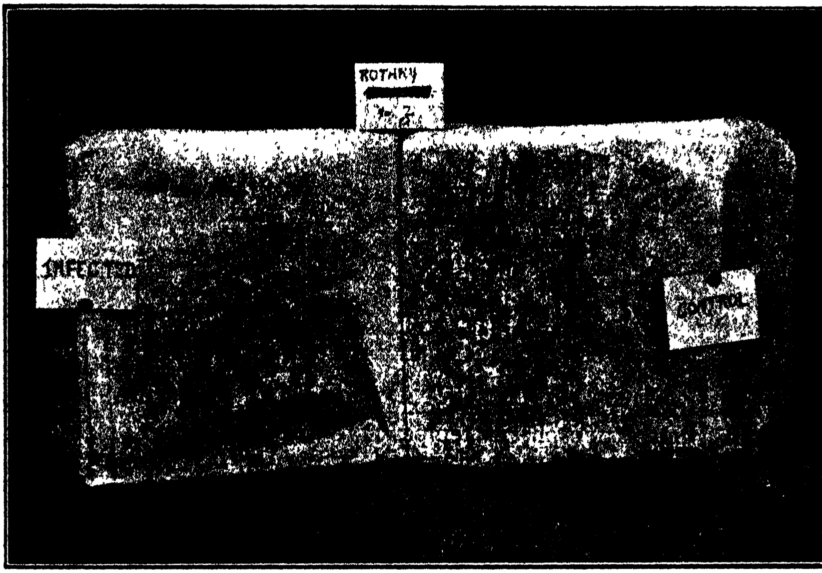

FIG. 7. SURFACE MOULD ON PARCHMENT.

Note the spreading growth from the artificially-infected box and the localized growth from the normal

[*Photo by H. J. Drake.*

The type of timber also plays an important part. White-pine timber in the experiments under review developed much more mould than Swedish pine. Whether this is due to a natural fungicide in Swedish pine or to the higher sugar content of white-pine was not investigated.

More important, however, than the observation on differences due to species of timber is that "heart"—close grained—white-pine timber scarcely supports mould-growth at all, while the softer sap-wood provides a splendid medium for mould. This is very clearly observed when a side is made of two pieces, one of hard wood, the other of soft (Fig. 6). The use of soft wood must therefore be avoided when dressing timber for butter-boxes. It is also important to observe that rotary-cut timber is much more sensitive to mould-growth than sawn timber.

The results obtained from the treatment of timber with an aqueous solution of the harmless fungicide sodium salicylanilide are most

encouraging. It would not be unreasonable to presume that the 0·1 per cent. solution with 10 minutes' immersion used in this experiment would give absolute satisfaction under commercial defrosting conditions, because the two boxes that were not entirely free of mould after treatment were only slightly affected and the experimental conditions were such as to encourage the maximum possible mould-growth. Further experimentation is required to determine the minimum strength of solution and period of dip necessary to prevent mould-growth. (Thereafter the extent to which it can be used depends upon treatment costs.)

The results obtained with the use of aluminium-foil parchment show that this wrapping has yet another advantage besides those which have already been described(4).

The results obtained with the ⅜ in. sawn Saranac container raise the possibility of using this as a standard export type. It combines the advantages of the ⅜ in. timber of the sub-standard with the structural advantages of the Saranac type and, provided that the sides are adequately attached to the ends, it gives every indication of being a reliable and attractive container.

Summary.

(1) Moulds originating in butter-boxes may infect the surface layer of butter packed therein and cause extensive damage.

(2) A double layer of 28/30 lb. parchment does not prevent mould mycelium from penetrating from the internal surface of butter-boxes to the surface of the butter.

(3) Mould-growth on butter-boxes is stimulated by (*a*) defrosting butter at high atmospheric temperature in air of high humidity; (*b*) the admission of air to the inner surface of the box; (*c*) the use of sap timber in place of heart timber; and (*d*) the treatment of timber by processes which render it more susceptible to mould-growth.

(4) Quarter-inch butter-boxes made from rotary-cut white-pine timber are very susceptible to mould-growth.

(5) Standard, ⅜ in. sawn Saranac, sub-standard, and ¼ in. sawn Saranac boxes made of white-pine do not readily develop mould-growth, but they are increasingly susceptible to infection in the order named.

(6) The "springing" of the sides from the end of Saranac boxes and the admission of air along the sides readily stimulates mould-growth on the internal sides of the boxes.

(7) Swedish-pine timber, impregnated with wax, is less susceptible to mould-growth than white-pine, but imparts an undesirable timber taint to the surface of the butter.

(8) Immersion of butter-box timber in an aqueous solution of sodium salicylanilide promises to be an effective method of preventing mould-growth in butter-boxes.

(9) Aluminium-foil parchment prevents mould from penetrating from infected boxes to the surface of butter packed therein.

Acknowledgments.

Dr. F. H. McDowall, of the Institute staff, examined the surface of the butter for the presence of Shirlan W. S. Three vendors of butter-boxes made available the various types of boxes used in the experiments,

and the National Dairy Association provided, free of cost, the aluminium-foil parchment. Mr. H. Drake photographed the boxes, and Mr. J. W. Smith, Dairy Factory Superintendent, supervised the packing, defrosting, and examination of the butter.

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COMMERCIALIZATION OF HYBRID-VIGOUR IN THE TOMATO.

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HYBRID-VIGOUR.

FERTILIZATION in plants is effected by the union of germinal material present in the pollen (male) and the ovules (female) resulting in a new individual which derives its germinal constitution from its parents. The germinal material carries genes which are transmitted to the progeny, and it is the expression of these genes in the progeny that determine its appearance and behaviour.

Certain of the genes are responsible for the expression of such characteristics of the plant as maturity, vigour, fruit-production, and disease resistance. The more desirable reactions of these characteristics are generally partly or wholly dominant over their alternatives, and therefore if brought in by means of crossing they become manifest in the first generation.

It is unlikely that any single variety will carry a full complement of the large number of genes responsible for the expression of these desirable characteristics, but any one variety will carry certain of them, and the genes that are not carried by it may be carried by some other varieties. This opens up the possibility of combining in one individual the desirable characteristics of the two varieties, thereby increasing the productivity of the hybrid beyond that of either parent. Success depends, of course, on the possibility of finding two varieties which are of mutual help in this respect, each bringing in its quota to be combined in the hybrid. This expression of vigour is termed hybrid-vigour, or heterosis.

Varieties which are alike in appearance may have much the same origin, and therefore carry much the same range of vigour factors. In such cases the hybrid may show little or no increased vigour. On the other hand, varieties dissimilar in appearance are likely to be of dissimilar origin, and when crossed give a greater measure of hybrid-vigour. This generally proves to be the case.

The possibility of capitalizing hybrid-vigour depends upon its extent and the cost of producing hybrid seed. It is likely to be most attractive commercially when a little labour results in the production of a large amount of seed. The tomato is an example in which one cross will furnish a large amount of seed, and it is found that the measure of improvement resulting from certain crosses more than compensates for the cost involved in producing the hydrid seed. Generally speaking, the hybrid is earlier, produces a heavier yield, and the fruit is intermediate in appearance between the two parents.

Plants like wheat and peas that are self-fertilized become "fixed," and the progenies of a single plant resemble the parent. The tomato is dominantly self-fertilized and therefore, generally speaking, its characteristics are "fixed." In this event the first-generation hybrids are all alike, although differing in some respects from either parent. This uniformity is not permanent, for in the second and subsequent generations segregation occurs and many variations arise. It is from this segregating material that the plant breeder makes his selections and later attempts to "fix" them. Naturally the same position arises in the case of the hybrid-vigour. Its expression is at its maximum in the first generation following the cross, and is not permanent because in subsequent generations segregation occurs and hybrid-vigour becomes less progressively with each generation.

The problem then resolves itself into finding varieties which when crossed result in some definite improvement above either parent along the lines of increased yield, earlier maturity, or improved quality.

Several workers have investigated the possibilities of commercializing hybrid-vigour in tomato-production. In general, hybrid-vigour has been demonstrated, and in certain cases this has been reflected in an increased yield of fruit and in precocity. Alabouvette and Titard (France) found the greatest increase in two varieties with the least morphological resemblance.

New Zealand Trials.

The trials to be discussed were conducted at the Plant Research Station, Palmerston North. Four varieties, selected at random, were used—namely, Large Red, Early Cluster, Kondine, and Sunrise. Kondine and Sunrise proved to be very similar in nearly all respects, and Early Cluster was not markedly different from these. Large Red, however, proved quite distinct in maturity, growth, yield, and shape of fruit. It was unfortunate for the purposes of this trial that three of the varieties were so similar to one another.

The varieties were crossed one with another, both ways, in 1933–34, and the resulting hybrid seed was sown in 1934–35. The seedlings were planted out, staked, and pruned to a single stem, in a manner similar to that adopted generally by commercial growers. Each plot consisted of five plants, the hybrid plot being grown alongside the parent plots for purposes of comparison, and the whole trial replicated three times. The fruit was picked and weighed when it showed colour, and usually two pickings each week were found necessary. This allowed determination of not only the total yield but also the earliness of maturity (precocity).

General Observations on Results.

It was observed throughout that the hybrid plants grew more vigorously than the parents, but no measure of this was attempted. The

hybrid fruit was, in appearance, intermediate between the parents, although this observation was possible only in the crosses with Large Red, which was sufficiently distinct from the other varieties (Fig. 1). In certain cases the hybrid plants gave a greater yield than either parent, and in nearly all instances were noticeably earlier.

As yield and maturity are the two most important factors, these will be considered in respect to each cross. There were fourteen weighings taken altogether, and the presentation of such a mass of detail would be confusing. The yields are therefore presented at three periods and as a total.

The first period is between 9th January, 1935, and 28th January, 1935. During this month tomatoes were scarce, and retailed as high as 8d. per pound ; therefore any increase in yield at this time was worth nearly double any in the succeeding period. The second period extends from 29th January, 1935, to 4th March, 1935, when tomatoes averaged a retail value of about 4d. per pound. During the final period, 5th March, 1935, to 22nd March, 1935, tomatoes could be purchased at as low as 2d. per pound, and at the final picking on 22nd March, 1935, all fruit, whether ripe or not, was picked owing to the danger of frost.

It is necessary therefore to bear in mind the importance of early maturity in assessing the value attending the use of hybrid seed. The yields given are those from three plots each of five plants, and in all cases the mother plant that was used in the cross is mentioned first and the pollen-bearing plant second.

TABLE 1.—LARGE RED CROSSED WITH KONDINE.

—	Yield of Fruit, in Pounds.			
	9th January, 1935, to 28th January, 1935.	29th January, 1935, to 4th March, 1935	5th March, 1935, to 22nd March, 1935	Total.
Kondine	11·0	80·8	31·4	123·8
Large Red	30·7	53·9	16·0	100·6
Kondine × Large Red	26·0	87·4	32·3	145·7
Large Red × Kondine	32·8	74·8	23·7	131·3

Kondine is the heavier-yielding parent and Large Red the earlier. Both crosses yielded more heavily than the heavy-yielding parent, and in maturity proved to be about equal to the early-maturing parent.

There has therefore been a distinct improvement, because it has been possible to increase yield and at the same time to maintain early maturity.

TABLE 2.—LARGE RED CROSSED WITH EARLY CLUSTER.

—	Yield of Fruit, in Pounds.			
	9th January, 1935, to 28th January, 1935.	29th January, 1935, to 4th March, 1935.	5th March, 1935, to 22nd March, 1935.	Total.
Early Cluster	16·4	89·0	41·1	146·5
Large Red	30·7	53·9	16·0	100·6
Early Cluster × Large Red ..	26·2	92·2	31·7	150·1
Large Red × Early Cluster ..	25·4	77·0	29·4	131·8

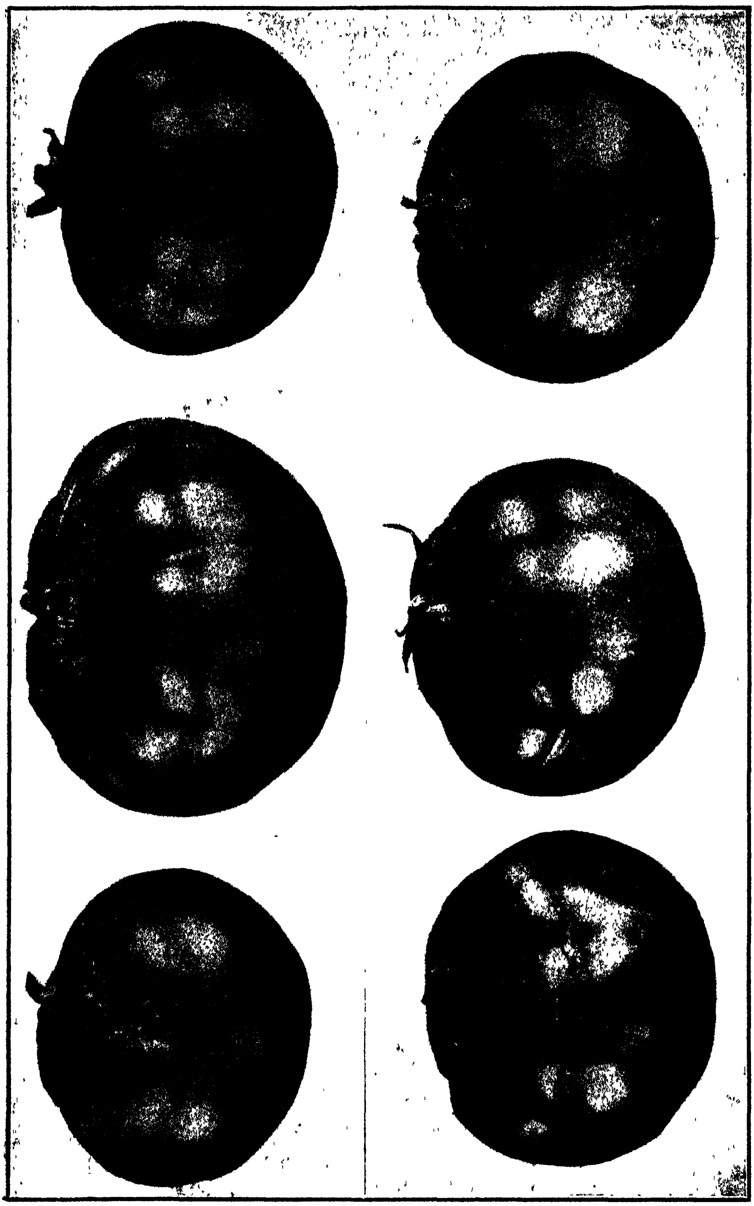

FIG. 1

Top: Left, Early Cluster; centre, Large Red; right, Kondine. Bottom: Left, Early Cluster crossed with Large Red; centre, Kondine crossed with Large Red; right, Kondine crossed with Early Cluster.

Of the parents in this cross Early Cluster outyields Large Red, but the latter is decidedly earlier in maturity. In Early Cluster × Large Red the yield is about the same as the heavy-yielding mother plant (Early Cluster), but is markedly earlier and approaching the maturity of Large Red. In the reciprocal cross Large Red × Early Cluster the yield is definitely above the maternal parent, but precocity not quite so marked.

It may be said of this hybrid that it approximates the yield of the heavier-yielding parent and approaches the maturity of the early-maturing parent. It does then to a large extent combine the good qualities of both parents.

TABLE 3—EARLY CLUSTER CROSSED WITH KONDINE.

—	Yield of Fruit, in Pounds.			
	9th January, 1935, to 28th January, 1935.	29th January, 1935, to 4th March, 1935	5th March, 1935, to 22nd March, 1935	Total
Early Cluster	13·5	98·5	43·6	155·6
Kondine	14·2	98·6	34·0	146·8
Early Cluster × Kondine ..	19·2	106·4	36·9	162·5
Kondine × Early Cluster ..	32·4	97·8	37·5	167·7

The parental varieties of this cross are seen to be somewhat alike in yield and maturity. Both crosses have given a small and probably non-significant increase over both parents, but the most striking difference is to be seen in maturity. The hybrid is definitely earlier than either parent.

The general similarity of the parents would not lead to the expectation of any marked increase in yield.

TABLE 4—KONDINE CROSSED WITH SUNRISE

—	Yield of Fruit, in Pounds.			
	9th January, 1935, to 28th January, 1935.	29th January, 1935, to 4th March, 1935.	5th March, 1935, to 22nd March, 1935	Total.
Kondine	14·2	98·6	34·0	146·8
Sunrise	12·9	98·7	29·4	141·0
Kondine × Sunrise	26·3	84·0	37·8	148·1
Sunrise × Kondine	25·4	86·7	37·7	149·8

It has already been pointed out that these varieties appeared almost identical, and the hybrids have given a very small, non-significant increase over the parents. In earliness of maturity the hybrids are, however, definitely superior to both parents.

Of other crosses made, Large Red × Sunrise was intermediate in yield between the parents, and in maturity was definitely earlier than Sunrise. The reciprocal cross was unfortunately lost, and comparisons cannot be made.

In the trial of Early Cluster × Sunrise, the latter variety proved to be both earlier and heavier-yielding than Early Cluster, and the

hybrid almost attained the heavy yield of Sunrise, and surpassed it in earliness of maturity. The reciprocal cross was in this instance also lost.

SUMMARY OF RESULTS.

(1) The use of first-generation hybrid seed of tomato does in the case of certain crosses result in a yield higher than either parent; failing this the trend is towards the higher-yielding parent.

(2) The use of such seed does in the case of certain crosses hasten maturity beyond either parent or, failing this, the maturity has a decided trend towards the earlier-maturing parent.

(3) Taking into consideration the combination of increased yield and earlier maturity, it would appear that sufficient improvement may be expected to warrant the cost of producing hybrid seed for commercial purposes.

(4) There is evidence that crosses between dissimilar varieties are likely to result in a greater measure of benefit than are those made between varieties of great similarity.

(5) These trials were designed to explore the possibilities of the utilization of hybrid-vigour. This being sufficiently proved, the next step must be to discover those varieties which, when combined, result in the greatest measure of benefit.

TECHNIQUE OF TOMATO HYBRIDIZATION.

The tomato is normally a self-fertilized plant. The pistil, or female organ, is a thin green projection arising from the ovary; it terminates in the stigma, which, when receptive, exudes a sticky secretion. This structure is enclosed within five anthers, or male organs, set on very short, stout stems or filaments. These anthers are joined laterally and are arranged in a cone-shaped formation with an opening at the apex. They are two-lobed and, when ripe, split along the line of dehiscence occurring on the inner side of each lobe. Thus the pollen is exerted inwardly, whence it comes in contact with its own stigma (Fig. 2).

It is essential for crossing purposes to know the stage in the development of the flower at which this pollen distribution occurs, for emasculation or removal of the anthers of the female parent must take place prior to this period. By a careful examination of a few flowers, the approximate stage at which pollen is freed can be recognized. It is generally when the flowers are about half-bloom; subsequent to this self-pollination will occur (Fig. 3).

When a flower suitable for crossing has been selected, most of the others on the same cluster should be removed; this allows for more favourable development. Emasculation may be effected quite easily with a pair of tweezers, though care must be taken not to burst the anther or to damage the pistil. If carried out at the half-bloom stage, the stigma is generally in a condition for immediate pollination, but, when effected earlier, which is preferable, a day or two should elapse before foreign pollen is applied; in this case it is advisable to cover the exposed stigma with a paper cover until ready for pollination.

The application of pollen is quite a simple operation. As it is advisable that the pollen for crossing should be as fresh as possible, flowers between the half-bloom and the full-bloom stage should be utilized. If the anthers are divided, an examination of their inner

surfaces will reveal whether or not the line of dehiscence has begun to split and thus whether or not the pollen has been exerted. The most satisfactory supply of pollen is available at the commencement of the splitting process. It may be applied by brushing the stigma

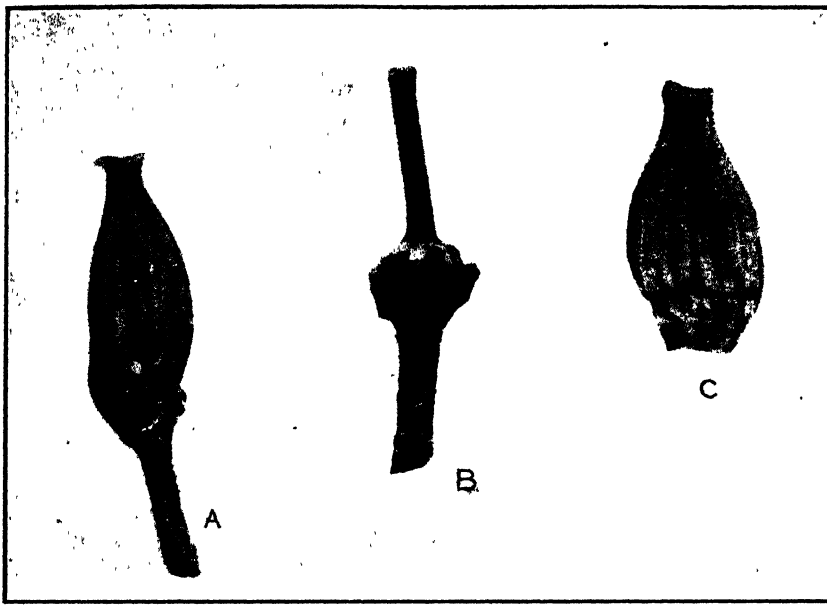

FIG. 2. PARTS OF THE FLOWER OF THE TOMATO.

A. Arrangement of stamens around pistil. Petals and sepals removed
B. Appearance of pistil and stigma. Stamens, petals, and sepals removed.
C. Inner surface of the anthers at about the stage for pollinating purposes.

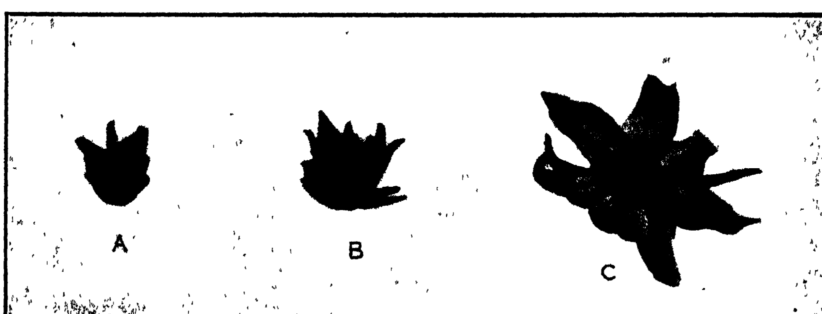

FIG. 3. STAGES IN THE DEVELOPMENT OF THE TOMATO FLOWER.

A. If emasculated at this stage a period of from two to three days must elapse before pollination.

B. At this stage pollination may be effected immediately after emasculation.

C. Full flower stage. The pollen-sacks have probably burst and the stigma already pollinated. It is therefore too late for crossing.

of the prepared female individual with the inner surface of the anthers ; if the stigma is receptive—and this can generally be determined by its appearance—the pollen adheres and fertilization takes place. For genetical investigation it is advisable to cover the effected cross with a waterproof paper cover, but for commercial purposes this is not necessary.

If a number of different crosses are being made consecutively, it is essential to wash the hands and any instruments with alcohol after each separate cross ; this renders ineffective any adhering pollen.

SAVING SEED.

The fruit should be picked when ripe and placed on one side till it is slightly over-ripe. It should then be pulped in a jar and allowed to ferment for about five days to liberate the seed from its surrounding tissues. When fermented a large quantity of water is added, and, after being well stirred, the pulp and flesh is skimmed off the top. If fermentation has been thorough the seed sinks to the bottom, and, by repeatedly adding water and decanting it, clean seed is obtained. The seed should be spread out to dry on some absorbent material. The seed should be dried thoroughly before it is stored away. The seed remains viable for several years, and hybrid seed need not be produced more frequently than every other year.

In determining the number of crosses to make it may be assumed that an average tomato gives two hundred seeds. To check this seventeen medium to small fruits were pulped. These yielded 3,300, or 194 seeds per fruit. Germination of good tomato-seed is generally about 99 per cent.

VALUE OF STRAINS OF RYE-GRASS IN CANTERBURY.

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CANTERBURY is recognized as one of the main cropping-areas in the Dominion, and the climate and soil conditions are particularly suited for this type of farming. Nevertheless, the greater part of the land is in pasture. Of the 2,750,000 acres of cultivated land, 1,750,000 acres are in grass over two years old, and about 250,000 acres are sown down in new grass each year. Cereals and pulse crops occupy about 500,000 acres and fodder crops about 250,000 acres. The 750,000 acres of crops are sown in rotation with pastures which remain down from two to ten years or so, and the young grass is sown at the end of a cropping programme. Owing to climatic conditions, these pastures fail to provide the necessary feed at two periods—namely, in winter and early spring as a result of low temperatures, and in summer and early autumn as a result of drought. It is necessary, then, to provide the supplementary feeds for these two periods. Turnips, hay, chaff, green-feed oats, and Italian rye-grass for the winter and early spring, and green-feed rape, soft turnips, &c., for summer and autumn periods. These supplementary feeds are essential, but they are costly to grow, so that any feed which can be secured from pastures at these times will

lower the cost of producing supplementary feeds, and will be more valuable than a heavier production during the periods when feed is plentiful.

Variations in the type of farming in Canterbury on the different classes of land and on different farms on the same class of land are frequent. One farmer might run a grazing-farm, another a cropping-farm, but the majority are engaged in mixed farming and can increase or reduce the grassing or cropping as the market conditions indicate. This is shown by the correlation between the number of sheep and the area in grass. For example, let us compare the two seasons 1932-33 and 1933-34. In the latter season there were 450,000 more sheep in Canterbury than in the former season. This increase was associated with an increase in grass area as follows: Old pasture, 56,000 acres; new grass, 49,000 acres, while 28,000 acres less seed (grass and clover) and 15,000 acres less hay were cut. In addition to the extra feed from pastures, there was an additional 14,000 acres of fodder crops. Cropping was reduced by 50,000 acres. This means that many of our pastures in the cropping district must be capable of remaining for several years in a productive condition when profits from lamb and wool are greater than the profits from cereal-growing—*i.e.*, the dominant species shown in a mixture should be permanent ones. When a period of profitable cereal-cropping arrives the farmer will then be in the position of having to make a decision as to which of his pastures he will plough up rather than in the position of having to plough up a field because there is no grass on it. And it needs little imagination to visualize the better crops which will be obtained when a good turf which has been well stocked be ploughed under than when a bare open caked surface be turned over. One is well aware that other factors, such as management, manuring, and climatic conditions, will all have their effect in making a good pasture, but, unless the foundation of perennial plants is there, a satisfactory long-lived pasture cannot be secured.

Perennial rye-grass can occupy the dominant position in most permanent pastures on the medium and better soils where it persists and its production is influenced by rainfall and management. It shoots to seed readily on the approach of dry weather and remains in a dormant state until conditions again favour growth. On the light plains it does not satisfy the requirements of a permanent pasture after the relative high fertility associated with fodder crops and cultivation has reached normal in two or three years. The rapidity with which these soils dry out and their low moisture-holding capacity make conditions too severe for permanent productive rye-grass pastures. For long term pastures on this class of land cocksfoot should form the dominant constituent in the mixture.

Strains in New Zealand Rye-grasses.

Some years ago it was the general experience that perennial rye-grass would not hold for more than a year or two on many areas in Canterbury. Dr. Hilgendorf, when he commenced work on grasses, drew attention to the fact that, in Canterbury, it was not so much perennial rye-grass that was at fault, but the strain of rye-grass used. He grew plots of the ordinary commercial rye-grass alongside plots of rye-grass harvested from a field which had been in grass from forty-five to fifty years, and at the end of two years about

90 per cent. of the plants from commercial seed and 5 per cent. or 6 per cent. of the plants from the old pasture had died. Mr. Levy, at Palmerston North, grew a comprehensive series of commercial lines of rye-grass from throughout New Zealand, and he showed that the only lines of true perennial which were being harvested and sold on the market came from old pastures in non-cropping areas, chiefly from Hawke's Bay, with the result that these lines now occupy the predominating position in the Department's certification scheme, which was started as the result of these trials.

ORIGIN OF STRAINS.

What is the origin of these temporary strains? Among the crops that are frequently grown in Canterbury is Italian rye-grass. Sown in summer or early autumn, it provides valuable autumn, winter, and spring green-feed for ewes and lambs when pastures are dormant. After the flush of other feed arrives it is shut up for seed. From 10,000 acres to 15,000 acres of Italian rye-grass are so used each year. This, in itself, would probably not have been detrimental to the perennial strain of rye-grass, but, in addition to its use as a fodder crop, a small amount of Italian was often included in the rotation pasture-mixture with the object of providing the valuable winter and early-spring grazing. These pasture-mixtures were predominantly perennial rye-grass, and, when conditions warranted, they were shut up for seed. The seed crop, especially in the first year, would contain a percentage of Italian rye-grass in it. If this mixture were only a mechanical one, and was purchased with this knowledge, no harm would result, but experimental work has shown that the two species, Italian and perennial rye-grass, are readily cross-pollinated, with the result that, in addition to a mechanical mixture, we get a biological mixture. Frequently this complex mixture was sold as perennial, and was included in a pasture-mixture together with a bit more Italian, and so the process went on for some generations, until many of the lines were predominantly Italian or Italian hybrids. They were temporary in nature, and contained a small percentage of perennial plants according to the number of generations that they were exposed to Italian contamination.

THE VALUE OF STRAIN IN RYE-GRASS.

In the first place, true perennial rye-grass is long-lived under a wide range of soil and management conditions, and should form the basis of mixtures for the rotation pastures of from two to ten years or so on medium to better class soils. The temporary strain thins out after the first year or two, and low-production grasses, such as brown-top, sweet vernal, fog, or Danthonia, establish on the bare spaces and soon gain possession. The widespread occurrence of these and other pasture weeds on many areas of cultivated land is mute testimony of the temporary nature of the sown species. The temporary strains, owing to their Italian "blood," produce earlier and more palatable grazing, and this superiority may last for a few months, but, after the first autumn, a high percentage of the plants die, so the strain is not at all suited for the long-term pastures. For one or two years' grazing on all soil types supplying the autumn, winter, and spring periods the Italian and red-clover mixture is supreme. The occupation of the sward by the

true perennial rye-grass under good management gives a higher carrying-capacity than a sward dominated by the low-producing but long-lived brown-top and Danthonia, and this in turn means higher fertility when the pasture is broken up for a period of cropping. The treatment which perennial rye-grass gets is responsible for its behaviour, and many pastures are ruined by overgrazing at critical periods. This applies particularly to the pastures of the light, shingly plains. During dry periods the perennial rye-grass dries up or shoots to seed, and unless there are supplementary feeds available the pastures are of necessity heavily punished by overgrazing. This period of overgrazing during drought weakens the plants, and those that do not die are unable to grow vigorously when conditions do favour growth.

PALATABILITY.

The question of palatability has been prominent in reference to the perennial rye-grass. There is no question that it is less palatable than Italian or than the "mixture" with which it has so often been compared to its disadvantage. When badly managed, the unpalatable nature can be so emphasized that sheep will not eat it, and go back in condition. Under good management, however, it forms the basis of a palatable pasture on which sheep thrive. Most of the criticism against perennial rye-grass has fallen on those pastures which were sown with pure rye-grass for seed purposes, those which had become rank before grazing, or those which had been cut for seed, the dry aftermath being grazed. Another condition which accentuated the unpalatable nature was the practice in cropping-farms of sowing the grass in the autumn after one or two cereal crops. Under these conditions the fertility is relatively low, the soil is dry and the tilth is poor, with the result that autumn growth of grass is slow and the plants are fibrous and lack vigour. This pasture will remain poor and unpalatable for two or three years, while one sown on a fertile and well-prepared seed-bed will be of high production right from the start. Palatability is important, for, after all, the feed is grown for the stock, and they eat less of an unpalatable food and consequently do not thrive. Therefore, every effort should be made to keep the grass as palatable as possible by sowing suitable mixtures, by grazing it when reasonably short, and by sowing under high-fertility conditions.

COMPETITION IN A MIXTURE.

There is another factor which must be taken into consideration, and that is the effect of competition of perennial rye-grass on its associate plants in the mixture. Perennial rye-grass is an aggressive plant not only in the first year, when it is severe, but also in succeeding years to a less extent. This aggression is the result of its relative rapid growth on a cultivated seed-bed, its strong growth under stocking, and the thickness of seeding which is usually applied. It thus competes with other plants in the mixture—cocksfoot, red clover, and white clover—which are slower to establish. The effects of this competition are not so marked when the mixture has been sown in November, December, or January, because the more slowly established plants, though checked, are

not killed, and, after some autumn grazing and dry weather has checked the rye-grass, they are enabled to become sufficiently well established to survive the winter, and later contribute to the feed-supply. When, however, the mixture is sown in late February, March, or April, as is commonly done in cropping-areas, the checking of the cocksfoot and clovers is responsible for their slow development, and the clovers are hardly out of the three-leaf stage and the cocksfoots are only small plants when the frosts come. In this stage they are subject to frost-lift, more especially when the ground is wet. In order to make conditions as favourable as possible for the other plants sown in the mixture with perennial rye-grass, early sowing should be practised and the young pastures should be judiciously grazed to prevent a smothering growth of rye-grass.

CONCLUSION.

The true perennial rye-grass strain is a long-lived perennial, and should form the basis of all long-term pasture-mixtures on all but the lightest and driest soil types, while the temporary type, which is not perennial rye-grass at all but a hybrid mixture, is short-lived, and should be omitted from all long-term pastures. There is a difference in palatability between the two, but the lower palatability of the true perennial can be minimized by sowing well-proportioned mixtures, by encouraging rapid growth, and by keeping the grass grazed to prevent its becoming tough or fibrous. The severe competition exerted by perennial rye-grass is responsible for a deficiency of associate plants in a pasture, but this can be minimized by early sowing and by grazing to prevent the rye-grass developing a smothering growth.

FACTORS LEADING TO EXCESSIVE WASTAGE IN THE PIG INDUSTRY.

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CONSIDERATION of slaughtering and inspection figures over the past season emphasizes the loss through condemnation of pig-carcasses or their rejection for export, which represents a serious loss to the farmers and to the country. It is, however, only a portion of the wastage in the industry.

MORTALITY AT BIRTH.

Mr. H. M. Peirson, Recording Officer of the Waikato Pig Recording and Research Association, in his annual report states that " A mortality of 22 per cent. had to be recorded between birth and weaning. The greatest percentage of deaths has been recorded as ' born dead,' which is not actually the case. Had some one been in attendance at the time of farrowing, the death-rate would have been reduced very considerably, as in many cases the pigs born (alive) died of suffocation." This is in recorded herds where the Recording Officer is advocating the value of management, and attention at farrowing, and where owners take more than average interest in their pigs. The loss at this period may well be greater over all herds.

Some of the farm loss through pigs being born prematurely, or imperfectly developed, or dead, is undoubtedly due to defective feeding of the pregnant sow. Successful breeders have shown that the supposed danger of sows being "too fat at farrowing" does not arise if the sow is active and healthy. As in the case of other stock, pigs provide evidence that better feeding of the pregnant mother results in heavier young being born. On the other hand, pregnant sows underfed, either through lack of green feed in dry autumn periods, or poor-quality herbage and no supplement, such as meat-meal and roots or milk, during the winter, are more liable to the above losses.

LOSS AFTER WEANING.

Further wastage occurs between eight and twelve weeks. This appears to be one of the most susceptible periods of the pig's life. It follows directly on weaning, and unless the creep system or other method has been developed to make the change from mother's milk less of a shock, and unless care and conditions at this stage are good, the pig suffers from the change in diet, it has frequently to contend with older pigs at feeding, and is exposed to the hazards of over-crowding and dirt. Even if the pig survives this period, under bad conditions it may contract some infection which, while not fatal, renders its carcass at a later stage unexportable or even unfit for consumption.

Fawcett. in a statistical survey of the position for 1934, estimated by a comparison of the number of pigs that should have been available for slaughter with those actually put through that there was a discrepancy of 125,000, or, in other words, a death-rate of 125,000 pigs.

Bacillus suipestifer infection is an important bacterial factor in the mortality at the eight to twelve weeks' period and will be dealt with later.

CAUSES OF CONDEMNATION AND REJECTION.

The following are the chief causes of condemnation and rejection: tuberculosis, pleurisy, peritonitis, septic wounds, faulty castration, arthritis, nephritis, bruises, and skin-lesions. It should be emphasized that, with the possible exception of tuberculosis, all are the results of defective management and are to that extent preventable.

McIlwaine, in this *Journal*, October, 1935, writes, "There is no doubt whatever that if greater attention is paid to the cardinal matters—improved housing, feeding, and improved conditions—the alarming mortality in young pigs would be reduced to reasonable proportions." To quote again H. M. Peirson, "The more pig-recording is extended the more definite has it become that management is the biggest factor in successful pig-keeping . . . It is still unsatisfactory to find that the pig is the first animal to be neglected on the farm. At haymaking and holiday-time the weights of many litters shows a considerable decline." What are the reasons for this? One might suggest failure to recognize the extent of loss and the value of housing and hygiene, overwork, and lack of sufficient time to attend to pigs, or a method of pig-farming not suited to the soil type and locality. Success in pig-farming is usually under one of the following conditions: Locality highly suitable with dry subsoil, sunny aspect and abundant natural shelter, plant big enough to employ one or more men the whole time, or else the owner or one of his staff keenly interested in pigs and able to take the time necessary to attend to them.

TUBERCULOSIS.

The most common source of tuberculosis is undoubtedly infected skim-milk. Other ways of infection are grazing after infective cows, association with other pigs in an advanced stage of the disease, or with tuberculous poultry, or possibly from a diseased mother. Bad housing, sanitation, and management cannot themselves cause the disease, but may be responsible for its spread and for its more rapid development in any pig once infected.

Visible signs of the presence of tuberculosis in the pig are not common. Detection of every possibly infectious cow in the herd is not easy without the use of the tuberculin test. Infections from this source could be lessened, however, were farmers to familiarize themselves with the suspicious signs, and to promptly report to their Inspector of Stock any cows showing these. They are—

(1) Tuberculosis of the lungs: Loss of condition and chronic cough, the cough being manifested after exertion.
(2) Tuberculosis of the throat-glands with peculiar carriage of head, abnormal "roar" in breathing, or swelling at throat.
(3) Swelling of any superficial lymphatic gland, the three chief being below ear, front of shoulder, and fold of flank.
(4) Tuberculous mammitis: Gradual increase in size and hardness of one quarter of the udder without previous acute inflammatory stage of ordinary mammitis

PLEURISY.

Pleurisy is inflammation of the normally smooth and thin membrane lining the inside of the chest and also covering the lungs. The condition found in slaughtered animals is usually a thickening of the membrane as a result of a previous acute attack of pleurisy. If thickened, the membrane must be stripped off, and the British authorities will not accept carcasses from which the pleura has been removed. Cases condemned are those in which the inflammation is still in the acute and fevered stage or septic fluid is present in the chest.

Practically all cases of pleurisy are associated with some degree of pneumonia, the symptoms of which we recognize in the piggery. Numerous specimens of lung from pigs found with pleurisy in slaughterhouses have been examined at the Veterinary Laboratory at Wallaceville, and in a large percentage *Pasteurella* organisms, believed to cause swine plague or infectious pneumonia, have been found.

Pasteurellosis, therefore, becomes of importance not only on account of the mortality it causes, but also because of ill effects (in the form of a thickened pleural membrane) left behind in recovered cases. According to one authority, the infection is more widely spread than the disease, suggesting that certain pigs may carry the infection without suffering.

Factors lowering vitality and rendering pigs susceptible thus become of importance, and these are poor housing, lack of shelter to runs, dirt, and overcrowding. Pasteurellosis may be introduced into a piggery by purchased pigs, hence the importance of isolating these for ten days.

Symptoms are cough, discharge from nose, watering of eyes, together with hurried jerky breathing. Condition may be lost, and deaths

occur; occasionally pigs over a fairly wide age-range and up to the heavy porker are affected. The trouble should be treated by isolating affected pigs, feeding light laxative diet including molasses and cod-liver oil, teaspoonful daily, in milk. It is advisable to spray houses and bedding with creasote and oil.

During the past season regular reports have been made by the Meat Inspectors on all lines of pigs in which the percentage of tuberculosis or pleurisy has been unduly high. These have been referred by the District Superintendent to the Inspector of Stock in the district concerned so that conditions on the farm could be noted and advice given if necessary. The following are extracts from reports of Mr. E. A. McKinlay, Inspector of Stock, for Hamilton on some of the many farms visited, pleurisy up to 16 per cent. to 20 per cent. having been found in pigs raised on them: (1) Stores had been run in the open without houses for a time during a period of wet, cold weather. (2) Conditions very bad, poor draughty houses, pigs sleeping mostly in the open under trees. (3) One small house, many sleep in the open. (4) Unsatisfactory, no house or shelter. (5) House raised on piles and draughty, piggery exposed. (6) Heavy wet land, houses draughty, runs small and dirty.

In other instances conditions were good, but pigs had been bought at sales and seeds of disease already sown. It has been felt that feeding is an important factor in disease-control, particularly more complete feeding of the younger pigs, sufficient starchy foods in winter, and mineral supply. However, amongst those pig-farming successfully there is a wide diversity in feeding, including skim alone, whey and meat-meal, maize and roots, extensive grazing, and sty-feeding. The above reports suggest that poor housing and lack of shelter are two of the most important factors leading to excessive pleurisy.

Pigs can be reared free from pleurisy. A recent experiment at Ruakura, carried out by the Fields Division to test certain feeding-methods, concerned thirty pigs. These were raised to the eight-weeks stage on a standard milk-meal ration and thereafter run in different lots under different conditions of feed and management. Housing mostly was not elaborate, but draught-proof and floored. Paddocks or pens were reasonably sheltered and clean—used for pigs for the first time twelve months previously. Feeding was of various types after eight weeks, but milk and meal were fed at regular hours and in measured amounts. No cases of pleurisy were found on slaughter.

In a second instance, out of 120 pigs put through, only three were found to have pleurisy. The owner here was an enthusiast and a great believer in good housing and the value of bedding, which was changed daily and sometimes twice daily. The three pleurisy cases were believed to be three pigs which refused to sleep inside.

PREVENTION OF PLEURISY.

Prevention of pleurisy therefore appears to depend on attention to the following points:—

Housing.—The house must be tight-walled to be free from draughts, but ventilated below the roof, and have wooden floor; felt or wood beneath an iron roof keeps it warmer in winter and cooler in summer. Designs for houses are readily available. Provision of a concreted yard in front of the house is useful, particularly in wet country, as

pigs may be confined to the house and yard during very wet weather. Proper provision of *drainage* from the yard is essential to keep surroundings clean.

Shelter.—For the runs where the pen system is followed shelter is perhaps even more important for pigs than for other classes of stock. Outbreaks of disease and in pigs under record a marked check in rate-of-weight increase have been frequently observed during spells of cold southerly weather where housing and feeding were satisfactory, but runs badly exposed to bleak winds.

Shelter may take the form of artificial barricades of wood, iron, or scrub on windward side of runs or suitably close live hedges. Pampas requires fencing till established, but when mature makes a dense mass which is almost a substitute for a house.

Other points are cleanliness, avoidance of overcrowding, regular feeding, adjustment of amount of food to rate of growth, change of run where necessary, and the various other points summed up under the term "good management."

PERITONITIS.

Peritonitis is inflammation of the membrane lining the belly cavity, and covering the intestines and other abdominal organs. As seen at the works, it resembles pleurisy in that many cases show only the thickening of the membrane resulting from a previous acute attack, but "stripping" is necessary. The percentage of peritonitis was higher than usual last autumn, probably as a result of the wet summer. In the field it is frequently found associated with *Salmonella suipestifer* infection, and preventive measures will be dealt with under that head. It may follow post-castration infection.

NEPHRITIS.

Nephritis is inflammation of the kidneys, acute or chronic. Bacterial infections, including *suipestifer*, have played a part.

ARTHRITIS.

Arthritis, an inflammation of a joint, frequently the stifle, with excess discoloured synovia present, is also in many cases due to an infection, *suipestifer* having been found in some. A percentage of cases may be set up by bruising of the joint, possibly through climbing up on to feeding platforms.

SALMONELLA SUIPESTIFER INFECTION.

Infection by *Salmonella suipestifer* is thus apparently an important factor in the production of the three previously named lesions, but it is also one of the chief causes of mortality in young pigs.

In suckers it is one cause of scours, if houses are contaminated and conditions dirty. In older pigs pneumonia is often present, evidenced by jerky breathing and loss of condition. Bowel-lesions are also common, either with pneumonia or independently, varying from small ulcers to extensive thickening—the so-called necrotic enteritis. The symptoms of this are usually chronic scour, marked loss of condition, pigs becoming skinny. Peritonitis is nearly always found in such cases. Deaths from a very acute infection may occur before the above signs develop, dead pigs often showing blue discoloration of belly and thighs

(" blue belly "). The feature of *suipestifer* infection is the periodic occurrence of deaths, and the presence of odd, skinny unthrifty pigs showing the above symptoms. It is largely a dirt-disease, and infection becomes active where resistance is lowered.

PREVENTION AND CONTROL.

Prevention and control are in the direction of greater cleanliness, especially at feeding-places, change of runs if the ones in use are old and contaminated, and avoidance of overcrowding, which is a potent cause of spread. The obviously unthrifty pig which is merely distributing infection should be destroyed. Thoroughly clean out all milk-containers, add some lime, and for a period a daily amount of a chlorine disinfectant —say, a teaspoonful per 40 gallons. Feed a little whole milk to smaller pigs ; cod-liver oil is useful. Access to good grazing often helps. Give necessary attention to housing. Small doses of sulphate of iron solution to suckers will check scouring.

FAULTY CASTRATION.

Castration is a surgical operation, incision being made into clean, healthy tissue, and healing should be rapid and uneventful. Occurrence of large tumour-like swellings points to infection. Castration should be carried out at an early age, and Waikato Recording Association pigs are usually castrated at three weeks old. It is essential that pigs should be clean when operated on, and imperative that for ten days afterwards they should be kept strictly clean, either confined to a clean house or preferably in a clean grass run, with clean house and feeding-space available. Do not apply strong antiseptics on or in wound, and rather use an antiseptic on skin before operation, preferably tincture of iodine.

SEPTIC WOUNDS.

Septic wounds are the result of infection by dirt organisms of any wound or scratch. They may occur on any part of the body or limbs ; about joints they may cause severe lameness. The infection may attack gums and lips of suckers. Many respond to treatment by first scrubbing the sore well to remove dead tissue, and then dusting with tartar emetic. Repeat in a week. If in the mouth, swab with iodine.

Overcrowding at feeding-places, quarrelsome pigs, excess barbed wire all tend to cause wounds, and filth harbours the infection. One may see such cases occasionally where pigs have quite a clean range on grass but come into some filthy pen for milk.

SUMMARY.

Much of the loss due to the presence of tuberculosis in pig-carcasses could be prevented by more prompt detection and elimination of the dangerous cow in the dairy herd.

Condemnations and rejections for pleurisy, peritonitis, faulty castrations, and septic woulds could be lessened, and pig-mortality on the farm reduced, by attention to the following matters : Good draught-proof housing, with sufficient accommodation for all pigs and bedding in cold seasons ; clean runs and feeding-places ; correct feeding, particularly of the pregnant sow, and of the litter and weaner, along the

lines developed by recording clubs; adequate shelter for pens or runs; avoidance of overcrowding either in houses, in runs, or at feeding-places; temporary isolation of all newly bought pigs.

Good management comprises all the above matters, and also includes that little measure of interest in the pigs and attention to detail without which the best of plants may fail.

VINE-CULTURE UNDER GLASS.

(Continued.)

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THE TREATMENT OF ESTABLISHED VINES.

CLIMATIC conditions vary so greatly in different parts of New Zealand that treatment which would be correct in one part is quite wrong in another. The climate of Auckland, some parts of Hawke's Bay, and of a few other localities is essentially different from that prevailing in the South Island and most parts of Wellington and Taranaki. It is evident that, in places where in summer the climate is almost tropical, more ventilation is necessary than is the case in cooler districts. It is a fact that the grape-vine will thrive in places having a much higher average temperature than is recommended for its culture in standard books on the subject. There is, however, a limit, and when the temperature under sun-heat rises much above 90° F. any further rise must be checked by increased ventilation. In most places where grapes are grown a much lower mean temperature prevails than is the case in the few warmer places mentioned.

In general practice it is inadvisable to make use of the bottom ventilators before the berries begin to colour. The effect of admitting bottom air while the foliage is wet has already been explained. In that case, however, young vines were being dealt with, a very different matter to that of established vines carrying a crop of fruit. Vines in full foliage and carrying fruit always hold more or less moisture on their surfaces. This is the case even where damping-down is of a minimum character, and there is danger in admitting bottom air if the outside air is appreciably colder than that inside the house. In warm districts and during calm weather this condition would not be present, therefore no harm would result from the use of the bottom ventilators provided obvious moisture had been first dispersed.

It is rare to find in this country vineries that are absolutely airtight. In most houses there is some space between the bottom pane of glass in each run and the sill; and this is a good feature, worth securing in all but the coldest districts. Air entering through these spaces passes up between the leaves and the glass. It has very little effect on the temperature in the house, but vastly improves the texture of the leaves, making them firm and leathery, a very desirable condition.

BEARING LATERALS.

The universal practice in the cooler districts is to leave only one lateral to each spur. Commercial growers usually train the rods more closely together than is the custom with private growers, and so secure a larger

number of smaller bunches. The system in other respects is the same in both cases. The one-lateral system is the only one by which the surface of the leaves can be properly exposed to the sun, which is a necessity in successful culture, and must be considered so in most situations. Besides this, the attention required in stopping, tying down, &c., is more handily given, and the suppression of pests is made as easy as possible.

Circumstances do sometimes occur where a departure from the rule of one lateral to the spur may be advisable. Cases are known where two, three, and four laterals have been left, each of which carries one or two bunches, which are well ripened. These cases are in the North, where the climate is such as to allow liberties not possible in most other places, and the houses are very large, so that there is a good body of air; and the borders are extensive, of the best of soil, and well fed. Though so far successful, this system cannot be recommended for general use. In most parts it would result in failure, while the same results could be secured by the safer plan of an increased number of rods and one lateral to each spur, which method will be followed in this series. None but experienced growers should depart from it.

ROUTINE WORK.

Pruning should be done in the early part of June, or earlier in warm districts, when all the principal leaves have fallen or would fall if the rods were shaken. Pruning should not be delayed when this stage is reached; the vines are benefited by a good rest, and, moreover, late pruning causes bleeding, with consequent weakening of the vines. Each lateral should be cut back to the base bud, the lowest prominent eye, cutting squarely across about ½ in. above the bud. It is bad practice to cut close to the eyes. If this is done, and the vines break strongly, the laterals have not sufficient foothold and are liable to grow off, resulting perhaps in a barren spur.

After pruning, any loose bark on the rod should be stripped off, but bark which is not loose should not be removed. The practice of stripping off all the bark that can be removed is quite wrong: it weakens the vine and prevents the rods thickening as they should. If diseases or pests are present, washing or dressing the rods may be necessary: this is dealt with in a later section. If the rods are clean no dressing is required.

In spring the top buds have a tendency to break into growth before those on the lower part of the rods, and if this occurs the top laterals get ahead of the others and tend to so weaken those at the base of the rod that dead spurs result. To cause an even break, after being pruned and dressed, the upper half of each rod should be left loose, so that it may bend down in the form of a bow, and be kept in that position until the buds on the lower part of the rods have started to grow.

During the dormant period all the ventilators should be kept open; this ensures to the vines a thorough rest. This is one of the advantages of having the house reserved for vines, for when the house is shared by other plants ventilation is adjusted to their needs and higher mean temperature is maintained, which may cause the vines to start too early into growth in the spring. Except where vines are forced for early crops and heat maintained, it is not

desirable to start the vines until a steady rise in outside temperature may be expected. If vines are started too early a spell of cold weather may cause a check in growth, which is a result to be avoided.

When the time arrives for the vines to start growth the bottom ventilators should be kept closed. Syringing the rods, and so creating a moist atmosphere, is considered to assist the vines in breaking. When all the buds have broken and made a few inches of growth the rods should be suspended in their proper places. A good time to get the rods into their proper positions is when the shoots average from 4 in. to 6 in. in length. The tying-up of the vines requires to be done with care, otherwise laterals may be broken off. The risk is greater where the shoots have made much growth. The laterals rarely break quite evenly; some are more advanced than others.

As recommended earlier, each lateral should be pruned back in winter to the lowest prominent eye. In all but rare instances there are other dormant buds close to the one pruned to, which, though less prominent, will in some cases break quite as strongly as the one selected. The two strongest and well placed laterals on each spur should be kept until they have advanced in growth far enough to allow the selection of the one that promises to produce the best bunch of fruit. All but these two should be rubbed off as soon as the rods are suspended in their places, or as soon as they show after that time. When the final selection has been made the spare laterals should be broken off from their base.

The growth of the laterals at this time is very rapid, and, as it is highly important to prevent waste of growth, constant attention is necessary. Each lateral should be "stopped" at a point two leaves beyond the bunch of grapes nearest to the old rod. It may be that the second is the better bunch, and when this occurs it should be retained instead of the first. In such cases the lateral should be "stopped" at a point one leaf beyond the second bunch. In the case of close planting it may be necessary to stop at one leaf beyond the first bunch, so as to leave room for the extension of the lateral from its next break. In this case, if the second bunch is retained, stopping must be close to the bunch. This can safely be done to a limited extent, and, in fact, often is. There is no need for haste in selecting the bunches to retain; they do not become a drain on the vitality of the vine until the berries begin to swell. It is best to wait till the berries are set, as it sometimes happens that some bunches do not set well. Surplus bunches should, however, be removed before much swelling of berries takes place.

Where there is no fruit on any of the laterals on a spur, a well-placed lateral should be pinched back to one or two leaves and all new growth pinched back to one leaf. This lateral may then be pruned back in the winter to the base bud.

Stopping the laterals should be done by pinching off the tips with the thumb-nail. It is harmful to allow them to extend so that several joints have to be removed. The removal of a considerable amount of leafage. as would result from this practice, causes a severe check to the roots, and, what is far more important, the vitality expended in producing the extended lateral growth will have been lost.

Tying down the laterals is at times an operation requiring great care. If the laterals are stout they are extremely brittle, and are easily broken out of the spur. To bring such laterals safely down to the wire, hold the base of the lateral between finger and thumb of one hand and follow up the lateral with the finger and thumb of the other hand, giving a twist at each node sufficient to produce a crunching sound. After two or three twists the lateral can be bent down in safety. Where the trellis is a good distance from the roof tying down may be left till the base of the laterals becomes firm, as evidenced by a yellow appearance in the bark. The leaves must be kept clear of the glass, which may make it necessary to tie down a little at a time.

SUBLATERALS.

The treatment of sublaterals is a subject on which there is a wide divergence of opinion among experienced growers. In former times their extension was believed to be a necessity in promoting root-action. At the present time it is—and, indeed, has been for a number of years past—the practice of most commercial growers to suppress them altogether, breaking them out as soon as they show. It is held that if the vines grow strongly and make large leaves the sublaterals can be dispensed with. The advantage in doing this is a considerable saving of time, and in cases of close training it allows of a free passage of air among the leaves. An even spread of large leathery leaves is infinitely more valuable than any number of small and crowded leaves. One should be able to obtain an uninterrupted view between the foliage and the roof throughout the whole length of a fairly large house. If this condition obtains leaves will not be burned through pressing on the glass, and there will be no accumulation of moisture to cause burning and mildew, while the leaves, being exposed to light and suffering no injury, will be able to perform their normal functions properly.

SETTING AND THINNING OF THE BERRIES.

In this country there does not appear to be the difficulty in getting a good set of fruit that is experienced in the United Kingdom. No trouble of this kind has come under my notice except in cases where the vines had been badly treated or have been grown in a wet atmosphere. Varieties such as Lady Downe's and Muscat of Alexandria, reputed to be shy setters, have in my experience set quite freely. During the flowering-period the house should be kept rather dry — not entirely so, but "damping-down" should be moderate. Somewhere about midday vines of shy bearing tendency should be given a shake or jar just sufficient to cause a movement throughout the whole vine resulting in the dispersion of the pollen. The shaking should be repeated daily while the vines are flowering.

As soon as the berries are set they swell very rapidly. Surplus bunches should therefore be removed before the berries have swollen much, and should not be left for removal as thinning proceeds, as this would cause a waste of vitality. Varieties that are known to set freely may be thinned as soon as the blossoms fall, but shy setters should be left till the berries are the size of peas. The earlier thinning is done the easier it will be, and the better. If the berries crush each other before thinning is done the work is slow and difficult, and the berries will not afterwards attain full size.

There are different methods of thinning. The usual is to first remove unfertilized berries, and then ease the upper and crowded part of the bunch, removing the berries in the centre, and severely thinning those on the under-part of shoulders. A start is made at the bottom of the bunch, after selecting one berry to form the point. No exact rule can be laid down as to the number of berries to remove, this depending a good deal on the variety. Berries that have short footstalks require heavier thinning than those with long. John Wright, in the "Fruitgrowers' Guide," states the average

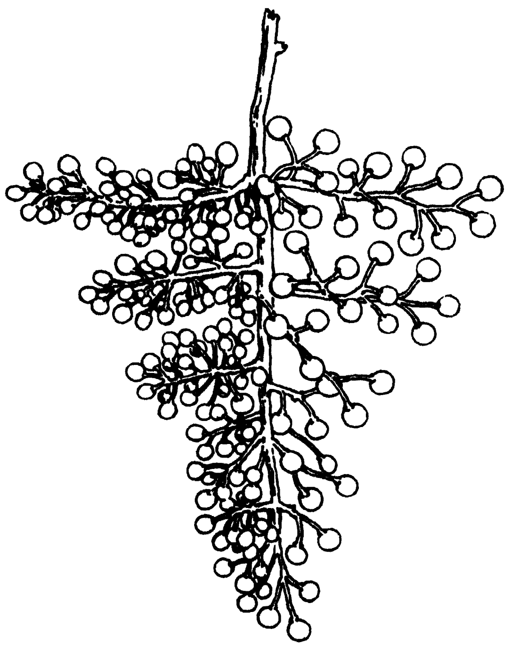

FIG 6 YOUNG BUNCH OF GRAPES, WITH ONE SIDE THINNED

number to remove is two-thirds on the lower parts of the bunch, half at the middle, and one-third at the top. This, however, must not be accepted as a fixed rule. Experience is the only satisfactory guide.

Thinning is usually done in amateurs' vineries with scissors made for the purpose, a button-hook or a forked stick being used to hold the sprays in convenient positions. Where there are distinct shoulders to the bunches these should be raised somewhat by strands of raffia fastened to the trellis. This should be done before thinning the bunch is commenced, as it permits the leaving of berries that would otherwise have to be removed, because they would be smothered by the shoulder. Commercial growers generally cut out all the loose shoulders before commencing to thin.

A quicker and less tiring method is to place one hand behind the bunch and pick out the berries with the other hand. The scissors cannot be entirely dispensed with. They are necessary for cutting diseased or damaged grapes out of ripe bunches when handling would spoil the bloom on the grapes.

(To be continued.)

FACTORS RELATING TO THE CONTROL OF SOFT-SCALD IN JONATHAN APPLES.

R. SUTHERLAND, Cool Storage Officer, Department of Agriculture, Wellington.

DURING the past four years cold-storage experiments have been carried out in co-operation with the Department of Scientific and Industrial Research and the New Zealand Fruit-export Control Board with a view to determining the causal factors over a wide range of circumstances and conditions contributing to wastage in Jonathan apples.

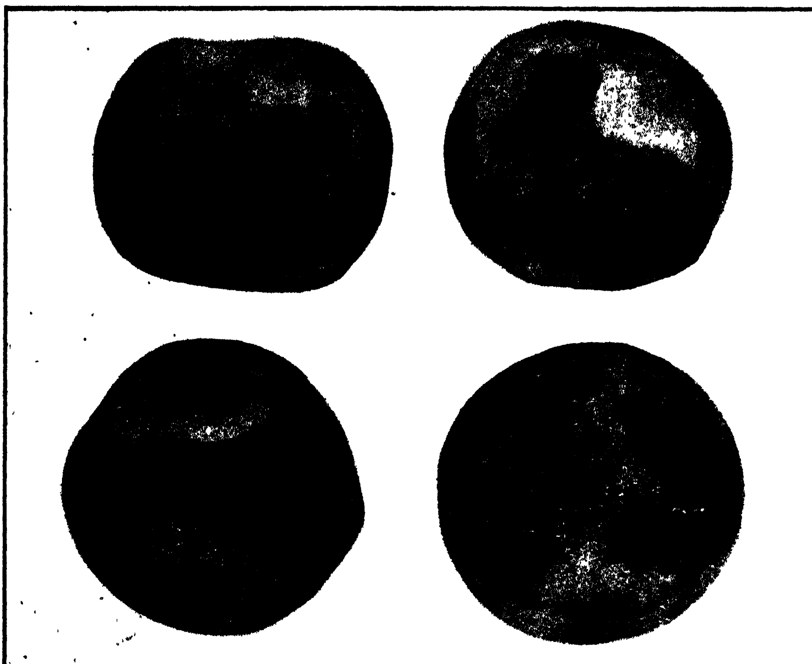

FIG. 1. SHOWING SOFT-SCALD IN FOUR STAGES OF DEVELOPMENT ON JONATHAN APPLES.

Overseas surveys(1), (2) have produced evidence that although the various types of wastage may be very slight when the apples are discharged at the docks, there may be a rapid development during the marketing period. The longer the marketing period, the larger and more mature the fruit at the time of discharge, the greater the amount of wastage.

The Jonathans concerned in the experiments were forwarded to cool storage in the Dominion through the usual channels as obtaining in export, and the examinations were conducted at such times as to

reproduce conditions comparable with a shipment arriving at its overseas destination and marketing of the apples subsequent to discharge.

DISEASES CAUSING WASTAGE IN JONATHANS.

Soft-scald.—Although soft-scald varies in its incidence from season to season, and in some seasons it is entirely absent, it is often the cause of more or less serious loss.

The disease, which usually makes its appearance comparatively early in the storage life of Jonathan apples, or shortly after their removal to atmospheric temperatures, is recognized by a browning of skin and underlying flesh, and, while in the early stages only a small area or a mere spot on the apples may be affected with scald, it spreads in an irregular formation and eventually covers the whole surface to varying depths into the flesh of the fruit.

Fungal Rotting and Internal Breakdown.—In our experiments with Jonathans very rarely have these two types of wastage been very serious when the samples were removed from cold storage, but they have developed in varying amounts as the fruit ripened.

The results have indicated that soft-scald is a very serious storage disease in Jonathans, and, while it varies in its incidence from season to season, susceptibility to the disease may likewise vary in fruit from different localities and orchards in the same locality.

Table 1.—Showing Seasonable and Locality Variations in the Occurrence of Soft-scald, Internal Breakdown, and Fungal Rotting Fourteen Days subsequent to Removal from Cold Storage at 37° F.

Locality	Soft-scald.			Internal Breakdown.			Fungal Rots.		
	Season 1933.	Season 1934.	Season 1935.	Season 1933.	Season 1934.	Season 1935.	Season 1933.	Season 1934.	Season 1935.
	%	%	%	%	%	%	%	%	%
5	6	Nil	..	1	5	..	3	..	..
6	Nil	,,	8	1	Nil	1	2	Nil	5
7	8	,,	12	4	,,	Nil	6	3	8
8	1	,,	1	Nil	,,	,,	Nil	Nil	1
9	Nil	,,	10	2	,,	,,	2	,,	4

The variation in wastage in Jonathans from season to season and from different localities is well marked. There was clearly an association between soft-scald and fungal rotting. Plagge, Maney, and Pickett(3) believe that the disease is identical with soggy breakdown, the chief differences between soggy breakdown and soft-scald being in appearance only. Although our results are in agreement that both diseases are due to low storage temperatures, and influenced by time of picking and undue delay before storing, the suggestion that the development of the disease stops when the fruit is removed from storage is contrary to our findings, for while, as with internal breakdown, soft-scald may have made very little or no development when the apples are removed from storage, it may increase very rapidly on exposure to atmospheric temperatures.

Table 2.—Showing the Influence of Temperatures of Storage on the Development of Wastage in Jonathan Apples Fourteen Days subsequent to Removal from Storage.

(The figures give the average wastage for three seasons in apples which were sound on removal from storage at 34° F. and 37° F. respectively.)

Soft-scald.		Internal Breakdown.		Fungal Rots.	
Temperature 34° F.	Temperature 37° F.	Temperature 34° F.	Temperature 37° F.	Temperature 34° F.	Temperature 37° F.
% 8	% 3	% 2·5	% 2·5	% 1·5	% 1·5

This result indicates that although soft-scald varies in its incidence —during some seasons it is entirely absent (Table 1)(4)—it constitutes the greatest amount of wastage in Jonathan apples; and therefore, as the figures show, the disease may be reduced to a minimum by storage or transport at a relatively high temperature.

To show (Table 3) a further result of the influence of relatively high temperatures in the control of soft-scald in Jonathan apples in 1933—regarded as a susceptible season—comparable samples of counts 198, 180, and 163 were obtained from three localities and stored under three sets of temperature conditions—viz., 34° F., 37° F., and at temperatures as obtaining in a precooler where large quantities of fruit were being loaded in and out daily, the temperatures varying from 42° F. to 32° F., the higher generally prevailing.

Table 3.

Soft-scald.		
34° F.	37° F.	42–32° F.
% 10	% 2·4	Nil

Although the effect of relatively high temperatures(5) has been pronounced in scald control, susceptibility to the disease may be increased by prestorage factors.

DELAYED STORAGE.

Delaying storage for ten days after gathering increased the disease and reduced the general storage life of Jonathans.

In this experiment the samples were gathered from the same trees at two stages of maturity. The second picking was made ten days later than the first, and, while half of the samples was placed in cold storage immediately, the other half was held in a packing-shed for ten days before being cold-stored under the same conditions as the first lot.

The experiment was carried on for four seasons, and, although each year the samples varied in susceptibility to soft-scald, the disease was always greater in its incidence in the delayed-storage samples from both the first and second stage of maturity.

Table 4.—Showing the Effect of Immediate and Delayed Cold Storage in the Control of Soft-scald.

First Picking.		Second Picking.	
Immediate Storage.	Delayed Storage.	Immediate Storage.	Delayed Storage.
%	%	%	%
2	5	3	8

The influence of placing Jonathans in cold storage with as little delay as possible was significant in reducing the amount of soft-scald, and, while there was very little difference in the amount of scald in the samples picked at an interval of ten days and stored immediately, the evidence indicated in both samples that delayed storage renders the apples less resistant to the disease. In addition to scald these samples were over-ripe, showing a tendency to breakdown and fungal rotting, and decidedly past their best marketing-condition.

Oiled Wrappers.

The effect of oiled wrappers in the control of soft-scald gave discouraging results. In the experiments, wrapping Jonathans in oiled wrappers as against comparable samples without wraps or in standard wraps did not give any appreciable control of scald. The writer is of the opinion expressed(6) that the term "soft-scald" is misleading in that it is not related to the trouble generally known as superficial scald, but rather to a form of external breakdown.

Packing-wraps.

Following the introduction of the one-piece-all-round corrugated wrapper for lining apple-cases and the unexpected development of soft-scald in Jonathans packed in the all-round wrapper, an investigation was undertaken to test the suggestion that the disease may be due to the same cause as superficial scald(7)—the accumulation of volatile substance brought about by the wraps restricting ventilation.

The experiments were arranged with Jonathans from a number of localities. These were packed in cases lined with the one-piece corrugated wraps, and the results subjected to comparison with comparable samples packed with strips of the corrugated wraps at the top and bottom only, and also no case lining.

As with oiled apple-wraps, the corrugated wrap treatments under review gave negative results in so far as the incidence and control of soft-scald is concerned.

Table 5.—Showing the Influence of Wrap Treatments on the Development of Soft-scald.

Experiment No.	Storage Temperature.	All-round Wraps. Soft-scald.	Top and Bottom Pads. Soft-scald.	No Wraps. Soft-scald.
	°F.	%	%	%
1	37°	5	5	4
2	37°	1	1	No test.

As this result is the average percentage of soft-scald for six cases of Jonathans in each experiment, the 1 per cent. less scald in the no-wraps treatment is not significant, and does not warrant any suggestion that the one-piece wrap is a factor in the development of the disease.

FERTILIZER TREATMENT.

Over a period of four years an examination of Jonathans from plots which received a combination of fertilizer treatments* in addition to the commercial application gave inconsistent and discouraging results with regard to overcoming susceptibility to soft-scald.

The influence of fertilizer treatments was most pronounced in crop-production, the trees yielding from five to eight cases of large-sized fruit 2½ in. to 3 in. each year, and there was some evidence that the additional manurial application resulted in the Jonathans being of a rather soft nature.

RAINFALL.

The results secured indicated that heavy rain towards the end of the growing-season rendered the apples more susceptible to soft-scald. During the seasons 1930 and 1933, when the rainfall for the two months preceding picking amounted to 11 in. and 9·5 in. respectively, the disease was more serious than in other seasons when the rainfall was not so great. The influence of heavy as against light soils was not significant with regard to the development of the disease, and contrary results were obtained; some seasons scald occurred in the samples from heavy soils, and the following season, while the samples from the heavy soils were almost free from the disease, those grown on light soils were affected.

SUMMARY.

(A) Jonathan apples vary in susceptibility to soft-scald from different localities and from season to season.

(B) Storage of Jonathans at low temperatures increases susceptibility to soft-scald.

(C) Delayed storage or cooling of mid-season and late-season more mature Jonathans increases susceptibility.

(D) Wrapping the fruit in oiled as against standard and without wraps did not appreciably control the development of soft-scald.

(E) Fertilizer treatments of the soil gave inconsistent and discouraging results in overcoming susceptibility to the disease.

(F) An increased amount of rainfall towards the end of the growing-season renders the apples more susceptible to soft-scald.

Control Measures.

Jonathans picked when they are mature (not immature or over-mature) are the least liable to soft scald.

Immediate cooling after gathering is recommended as a control measure.

Cold storage at relatively high temperatures (36° F. to 38° F.) provides a maximum of control.

* Commercial application applied to all the experimental trees: Basic superphosphate, 7½ lb.; sulphate ammonia, ½ lb.; sulphate potash, 1½ lb.; bonedust, 1 lb. Plot additions: (1) Sulphate ammonia, 2 lb.; sulphate potash, 2 lb. (2) Sulphate ammonia, 2 lb.; superphosphate, 2 lb. (3) Sulphate potash, 4 lb. (4) Superphosphate, 3 lb. (5) Sulphate ammonia, 4 lb.

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(1) Report of Investigation by the Economic Section of the Empire Marketing Board in the Deterioration in Transit of Australian and New Zealand Fruit, No. 46, 1931.
(2) The Prevention of Wastage in New Zealand Apples. Food Investigation Special Report No. 39.
(3) PLAGGE, MANEY, and PICKETT: Functional Diseases of the Apple in Storage. Bulletin No. 329, 1925.
(4) TINDALE, G. B.: Cool Storage Investigation, *Jour. of Agric.*, Victoria, February, 1932.
(5) HARRISON, J. E.: The Jonathan Apple in Cold Storage, *Jour. of Agric.*, Victoria, January, 1926.
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THE GYROTILLER.

EXPERIENCE IN SOUTH CANTERBURY.

W. C. STAFFORD, Instructor in Agriculture, Timaru.

A GYROTILLER commenced contracting in South Canterbury in April, 1935, and carried on throughout the winter and spring, working its way up from Waimate County through Levels and Geraldine, and left the district during September, returning again for a short period in October and doing further work in Levels. The itinerary of the machine is mentioned because it has a definite bearing on the results obtained in various parts of the district. The other factor which has brought about diverse results, and in many cases discredited the implement, are the claims made by the owners without having given due regard to the object of the cultivation, the season of the year, the state of the field, and the subsequent crop.

The farming community react in only two ways to any new innovation which is destined to interrupt their ordered or usual farming operations. They either treat the innovation with caution and have nothing to do with it until ample proof is available or they adopt the innovation wholeheartedly. In South Canterbury the gyrotiller was adopted immediately. The machine itself commands respect, if only from an engineering aspect; its depth and width of tillage seemed (and are) admirable for the type of soil in the district, being, as it is, for the most part, clay loam overlying a stiff clay subsoil. These, together with the claims of the owners of the machine, which were that up to 50 per cent. increases had been obtained by the use of the deep tillage due to the opening-up of fresh supplies of plant-food, and also that little or no cultivation was required after the gyrotiller had been used, persuaded the farmer to have contracting done irrespective of the most important matters mentioned in the last part of the preceding paragraph.

It was disregard of these matters that has caused any dissatisfaction which exists to-day regarding the work of the implement in South Canterbury. The proof of this lies in the fact that the farther north the machine went from Waimate the stronger the dissatisfaction with the results. As the machine went north, the later in the season was

the cultivation being done, and consequently less and less time elapsed between the cultivation and the sowing of the crop. An extreme case, and one where the dissatisfaction is the worst, is where the land was tilled out of lea in late September with the object of sowing swedes in November. The consequences of such an effort on the subsequent crop are obvious.

It will be assumed rightly from the foregoing that a doubt exists in South Canterbury to-day as to the usefulness of the gyrotiller. Really there is no doubt at all about the efficiency of the implement: used properly, the machine does effective work.

THE GYROTILLER.

As has been the case with many innovations in agriculture of recent years, over-enthusiasm and lack of attention to the first principles of agriculture have been the cause of discrediting the gyrotiller in some parts. Had the owners of the machine given due regard to the object of the cultivation, the season of the year, the state of the field, and the desired crop, instead of creating the feeling that the machine overcame all difficulties, the position to-day would not have arisen. Briefly, eagerness not to miss work last season will be a great hindrance to getting work this year in the northern parts of South Canterbury.

In the Waimate district, where contracting commenced in April, farmers had the work carried out with the object of putting the ground into potatoes, and results have been excellent. There is, however, no reliable way in which comparison of results on gyrotilled and on ordinary

cultivated land can be made. Cultivation in April on lea land with the object of sowing in September–October allows weathering and sweetening to take place, and this is absolutely essential where such a depth of soil is tilled and aerated for the first time. The weathering reduces the clods, and plenty of time elapses to rot the turf and make it available for the crop. It was a noticeable fact with the dry spring experienced that the gyrotilled potato crops held out better than others, while it was also said that drainage was better during the heavy rains following. Yields from the tilled land are most encouraging, and will probably average 15 tons an acre. Certified seed was sown in practically all the gyrotilled land, with superphosphate 3 cwt. an acre and sulphate of ammonia 1 cwt. an acre as the manure.

Outside the Waimate district the cultivation was carried out mostly with the object of putting the ground into swedes, turnips, and rape. Oats, however, were sown on some tilled land with fair success. Some excellent crops of swedes have been obtained where the work was carried out in early winter. As the machine has worked north and the season progressed, the results fall away, and some very poor crops are to be seen. It is noticeable, however, that in some cases where a certain amount of cultivation had been done prior to late gyrotilling the resultant crops are quite good, although the crop varies considerably from the sides to the centre of each width of the machine. The cause of this is that the rotary tynes have a tendency to bring up unweathered soil from below to the centre and transfer all the good soil to the outside edges of each width of the machine. This gives a crop, where the tilling has been done late, an undulating appearance. This feature is not noticeable in the Waimate district.

Lessons from the Experience.

The lessons to be learnt from the first year's working of the gyrotiller in South Canterbury are as follows :—

(1) Cultivation for any crop on any class of land should be carried out as early as possible. The following is suggested for crops following lea :—

If tilling is carried out for wheat in January or February, previous top-work can be dispensed with. After these months, tilling should be done only on land that has been skimmed or "hustled" earlier. No tilling should be done later than the middle of April. If rain fell on this later tilling it would be impossible to sow the wheat in the winter of that year because the land after tilling lies very open and cannot carry either horses or tractor for some considerable time. For potatoes and oats direct tilling should be done only up to the end of May. After that, tilling should not be done unless the top-work has been carried out earlier. In this case the tilling should be completed before the end of June. For rape, turnips, and swedes direct tilling can be done up to the end of July, and after that only on previously worked land up to the end of August.

(2) Direct late-tilling for any crop on a lea field has resulted, in the main, in the failure of the crop. This can be attributed to—

(*a*) The mixing of unweathered soil with the topsoil and consequent temporary sourness ;

(*b*) Lack of consolidation due to the stirring and opening-up of a considerable depth of soil ;

(c) The impossibility of reducing the topsoil to a sufficient tilth for a suitable seed-bed after tilling—due to the fact that as there is such a quantity of loose soil the lumps run in and out of the tines of the implements doing the top-work without causing any pulverization.

To ensure a successful after-crop it is advisable to gyrotill early to allow the top to sweeten and consolidate, and then to cultivate the top 4 in.–5 in. into a sufficient seed-bed for the reception of the particular crop desired, remembering that gyrotilling does not do away with the necessity of manuring the crop on the approved lines.

The effect of the deep cultivation in subsequent years has still to be observed. It seems, however, that it should be of great benefit in freeing the stiff clay of the South Canterbury Downs, resulting in better drainage and easier root-development of the plant.

On land infested with the more difficult twitches, such as creeping-fog and couch, yarrow, and other underground creeping plants, gyrotilling should not be done unless an absolute bare fallow is to be carried out for the following six or eight months. The action of the tillers mixes to a considerable depth much of the top turf, thus preventing the eradication of the rhizomes. On such land cleaning on the usual approved lines should take place before tilling.

Gyrotilling should not take place on land to be sown into grass that season. Lack of consolidation will result in a failure of the grass to establish.

One of the most useful features of the implement is the manner in which it can successfully deal with the corners of fields, neglected fence-lines, and isolated areas infested with gorse, blackberry, or broom of almost any height. It can till such places considerably more cheaply and more effectively than they can be cleared and ploughed by the usual methods.

Relation between Gyrotilling Contract Work and the Cost of Crop Production on the Farm.

It can be definitely stated that gyrotilling at the correct time increases the cost of production of the subsequent crop. The operation purely from a tillage viewpoint only does away with the usual ploughing operations—that is, skimming and deep-ploughing—the amount of top-work that has to be done after either method to procure a suitable seed-bed being approximately the same. Thus, allowing for skimming and cross-ploughing at 8s. 6d. per acre and deep-ploughing at 10s., the cost of production is increased as by gyrotilling £2 10s., less cost of ploughing operations £1 7s.: increased cost of production equals £1 3s. per acre. As to whether this increased cost of production per acre is offset by an increased yield sufficient to lower the cost of production per unit, whether it be a bushel of wheat, oats, &c., or a ton of potatoes or roots, is at present not known, as there is no reliable information available on the subject.

However, considering the class of work done, it would be unreasonable to charge the immediate subsequent crop with the whole cost of the gyrotilling operation. The work performed is of such a nature that its beneficial effects are likely to be felt for many years after the work has been done. A parallel case would be the effect of lime.

GRADING OF EXPORT BUTTER AND CHEESE.

LEADING DAIRY-FACTORY AVERAGES FOR THE YEAR 1935-36.

BUTTER-MANUFACTURING companies which have obtained for their export produce an average grade of 94 points or over, and cheese-manufacturing companies which have obtained an average grade of 93 points or over, are listed below.

Butter and cheese factories total thirty-two and twenty respectively, of which twenty-two butter and eleven cheese are situated in the North Island and ten butter and nine cheese companies in the South Island.

Butter-factories.

Company or Proprietor.	Registered No.	Brand.	Tonnage graded.	Average Grade.
Inter-Wanganui Co-op. ..	6	Inter-Wanganui ..	215	94·872
Kaikoura Co-op ..	302	Kai	167	94·869
United Co-op.	1220	Whariti	328	94·794
Karamea Co-op. ..	1570	Karamea	30	94·787
Awahuri Co-op. ..	664	Red Rose	990	94·770
Rangiwahia Co-op. ..	750	Quail	144	94·761
Kokatahi Co-op. ..	1144	Kokatahi	157	94·659
Golden Bay Co-op. ..	146	Sovereign	554	94·635
Levin Co-op.	910	Lake	1,659	94·630
Murchison Co-op. ..	1888	Airship	205	94·616
Rangitikei Co-op. ..	1360	Rangitikei ..	703	94·613
Lepperton Co-op. ..	49	Lepperton.. ..	285	94·557
T. and P Milk-supply Co., Ltd.	54	Sweet Briar, &c. ..	16	94·557
Shannon Co-op. ..	1489	Shannon	1,179	94·512
Collingwood Co-op. ..	1254	Golden Hills ..	206	94·505
Tamaki Co-op... ..	1463	Bell	474	94·460
Wangaehu Co-op. ..	1326	Wangaehu ..	637	94·438
Rata Co-op.	938	Rata	1,141	94·429
Golden Coast Co-op. (Maruia Branch)	387	Golden Dawn ..	37	94·413
Uruti Co-op.	300	Uruti	245	94·338
Rongotea Co-op. ..	8	Rongotea	956	94·294
Kuku Co-op.	905	Ohau	277	94·292
Midhirst Co-op. ..	110	Rugby	1,337	94·284
Rodney Co-op... ..	394	Rodney, &c. ..	511	94·283
Tikorangi Co-op. ..	102	Shield	432	94·283
Ruawai Co-op. ..	66	Ruawai	1,398	94·195
Arahura Co-op. ..	1516	Arahura	95	94·182
Masterton Co-op. ..	1307	Masterton ..	916	94·178
Taihape Co-op. ..	1188	Tikapu	611	94·158
Mangorei Co-op. ..	345	Mangorei	930	94·155
Eketahuna D. Co. ..	46	Eketahuna ..	179	94·109
Waitara Co-op. ..	726	Waitara	514	94·105

Cheese-factories.

Company or Proprietor.	Registered No.	Brand.	Tonnage graded.	Average Grade.
Omimi Co-op. ..	74	Omimi	63	93·679
Westmere Co-op.	1621	Westmere	325	93·669
Kaimata Co-op.	992	The Oaks	320	93·592
Marton Co-op.	660	Marton	25	93·531
Melton Co-op. ..	1030	Milton	108	93·531
Little Akaloa Co-op.	32	Little Akaloa	44	93·426
Stirling Co-op.	292	Stirling	340	93·400
Rapanui Co-op.	1714	Southern Grove	131	93·366
Bell Block Co-op.	71	Dove	164	93·288
Lowgarth Co-op.	629	Lowgarth	520	93·276
Barry's Bay Co-op.	401	Onawe	254	93·230
Kahui Co-op. ..	493	Kahui	262	93·181
Rai Valley Co-op.	519	Rai Valley	311	93·153
Newman Co-op.	966	Newman	189	93·124
Wairewa Co-op.	471	Wairewa	148	93·090
Bell Block Co-op.	488	Bell Block	393	93·071
Kaitangata Co-op.	1648	Kaitangata	124	93·069
Cardiff Co-op. ..	10	Cardiff	620	93·050
Cloverlea Co-op.	64	Cloverlea	134	93·022
Kai Iwi Co-op...	1565	Kai Iwi	101	93·006

—*Dairy Division*

RECENT REGULATIONS AFFECTING FARMERS.

THE following notes on regulations made under the several Acts mentioned below are of general interest to farmers:—

AGRICULTURE (EMERGENCY POWERS) ACT, 1934.

By the Calves (Sales for Slaughter) Regulations, 1936, which came into force on 18th June, the sale and collection of young calves intended for slaughter for human consumption as boneless veal is regulated with the object of safeguarding New Zealand's export trade to the United Kingdom in this class of meat. The regulations are aimed at ensuring that such calves are properly fed from birth and are sufficiently matured for sale and collection for slaughter. Incidentally, the regulations are intended to prevent any appearance of cruelty to such calves by reason of the failure on the part of dairy-farmers properly and sufficiently to feed them from birth and until disposal, or by reason of their unfitness on account of apparent weakness or immaturity to be driven or conveyed to the place of slaughter.

By the Dairy Industry Accounts Regulations, 1936, standardized forms of balance-sheets, accounts, and directors' reports for co-operative dairy companies are prescribed, and, commencing with the current manufacturing season, the directors of every such dairy company are required to prepare their report with respect to the state of the affairs of the company and the balance-sheet, manufacturing and marketing account, appropriation account, and statement of statistics of the company in the several forms prescribed and in accordance with the directions and instructions contained therein. The directors must attach to their report a copy of the balance-sheet and of each of the other prescribed accounts and documents.

All co-operative dairy companies and those non-co-operative dairy companies that send to their suppliers (whether shareholders or not) statements, reports, or accounts relating to their manufacturing operations are required to send to all suppliers—

(a) A report giving in respect of the previous year the estimated season-average pay-out per pound of butterfat which was quoted in the report for that year and the actual season-average pay-out that

was finally made, and giving, in respect of the current year, the valuation basis for dairy-produce unsold and the estimated season-average pay-out which should result from the disposal of unsold dairy-produce at the values adopted ; and

(b) A balance-sheet, manufacturing and marketing account, appropriation account, and statement of statistics compiled in accordance with the standard forms, together with a copy of the special form of Audit certificate set out in clause 3 of the regulations.

Owners of proprietary dairy companies and private owners of dairy factories are required to send to every supplier a statement containing the same information and particulars as is required of co-operative dairy companies respecting the pay-out to suppliers for the past and current seasons, and such statement must be supported by the special form of Audit certificate set out in clause 3.

Copies of all documents which by the regulations are required to be sent to suppliers must also be sent to the Acting Director of Marketing and to the Director of the Dairy Division of the Department of Agriculture.

By the Dairy-produce Levy Regulations, 1936, the Dairy-produce Export Levy Regulations, 1935, are revoked, but the existing charges fixed by the New Zealand Dairy Board by way of levy on dairy-produce intended for export continue to apply to all dairy-produce manufactured before 31st July but exported after that date, and shall be collected by the Customs Department as theretofore.

The new regulations prescribe the same maximum levies that were prescribed by the revoked regulations, but although the amount of the levies that may be imposed applies only to butter and cheese manufactured on and after 1st August such levies have been extended to include butter and cheese so manufactured, whether intended for export or for sale for local consumption. All moneys payable by way of levy on butter and cheese so manufactured and intended for export are payable to the Primary Products Marketing Department and shall be deducted from moneys payable to owners whose produce has been acquired by the Crown pursuant to the Primary Products Marketing Act, 1936. All moneys payable by way of levy on butter and cheese so manufactured and sold for local consumption are to be paid to the Department on demand, and for that purpose every manufacturer, being the owner or occupier of a creamery, cheese-factory, or whey-butter factory, who sells for local consumption any butter and/or cheese that has been manufactured after 1st August is required to furnish to the Department a monthly return of all produce so sold. Alternatively, such moneys may be deducted from moneys payable to the manufacturer in respect of any butter and/or cheese acquired from him pursuant to the provisions of the Primary Products Marketing Act. The residue of all moneys received by the Department in respect of such levies, after making a deduction of 1 per cent. thereof to defray the cost of collection, shall from time to time be paid to the Board.

The Stock Act, 1908.

By amending regulations under the Stock Act, which came into force on 23rd July, all cattle imported from Canada, the United States, or Tasmania (being the countries from which cattle may be imported into the Dominion) must be tested prior to importation with the Johnin test to determine whether they are affected with Johne's disease. The amending regulations also provide for the admission of horses, sheep, or dogs from the South-western Division of the State of Western Australia subject to reasonable safeguards against the introduction of disease into the Dominion.

The Seeds Importation Act, 1927.

By the Seeds Importation Regulations, 1929, Amendment No. 1, which came into force on 23rd July, Government certified perennial rye-grass seed may be imported from any country without being stained prior to importation in accordance with the provisions of the principal regulations.

—*A. E. Morrison, Solicitor, Department of Agriculture, Wellington.*

AGRICULTURAL STATISTICS, 1935-36.

Statistics for the season 1935-36 are now available, and figures for the principal items are here given, last year's figures being shown also for purposes of comparison.

Attention is directed to the fact that the crop figures relate only to holdings of 1 acre or over located outside borough boundaries. The live-stock figures, on the other hand, include allowances made for live-stock in boroughs and on holdings of less than 1 acre in extent.

PRINCIPAL CROPS.

Name of Crop.	Areas.		Yields.		
	1934-35.	1935-36.	Unit.	1934-35.	1935-36.
Wheat—	Acres.	Acres.			
For threshing ..	225,389	248,639	Bushel	5,933,245	8,859,223
For chaff, hay, or ensilage	2,230	2,075	Ton	3,997	3,862
Fed off or cut for green fodder	2,904	1,709	..	..	..
Oats—					
For threshing ..	52,516	77,502	Bushel	1,890,145	3,302,042
For chaff, hay, or ensilage	222,100	227,480	Ton	315,589	390,168
Fed off or cut for green fodder	61,802	58,314	..	..	..
Barley—					
For threshing ..	18,441	20,659	Bushel	484,689	745,380
For chaff, hay, or ensilage	753	923	Ton	1,547	1,895
Fed off or cut for green fodder—	9,537	6,195	..	..	..
Maize—					
For threshing ..	7,946	7,517	Bushel	373,219	321,222
For ensilage	438	558	Ton	2,980	4,149
Fed off or cut for green fodder	7,716	9,051	..	..	..
Peas for threshing ..	25,366	24,428	Bushel	436,534	562,733
Linseed for threshing ..	2,930	1,806	Cwt.	17,208	11,535
Potatoes	23,001	22,958	Ton	109,123	*
Onions	923	928	,,	5,592	7,089
Rye-grass, harvested for seed—					
Perennial	54,012	53,552	Lb.	17,117,118	19,473,245
Italian and Western Wolths	12,436	13,073	,,	4,800,514	6,160,949
Cocksfoot harvested for seed	12,309	13,516	,,	1,876,386	2,374,909
Grasses and clovers cut for hay	404,156	453,353	Ton	744,272	851,263
Grasses and clovers cut for ensilage	80,595	82,665	,,	323,854	334,759
Lucerne cut for hay or ensilage	39,087	40,857	,,	115,005	118,479
Turnips (including turnips and rape mixed)	449,513	441,854	..	..	..
Mangels	11,211	13,210	..	..	..
Tobacco	1,358	1,518	Lb.	1,106,424	1,065,693

* Not yet available.

SEASONAL NOTES.

THE FARM.

Co-ordinate Phases in Grass Farming : Utilization and Production of Feed.

At times neighbouring farmers working with pastures and stock which are essentially similar obtain very different returns from identical top-dressing programmes. One of the factors which readily may cause the different results is of particular current importance. It arises from the fact that top-dressing normally results in the production not only of extra feed when it is badly needed, but also of extra feed at seasons when there would be ample feed without top-dressing. If this latter additional feed is not appropriately used, and if it is allowed to lead in spring and early summer to the development of coarse stemmy growth, then the good done at one season by top-dressing may be nearly, or even more than wholly, counterbalanced by the undesirable results at the later stage. In short, really judicious autumn or spring top-dressing may be far from fully effective because its subsequent influence is not controlled or modified suitably. Hence farmers at times condemn top-dressing without any true justification for doing so. Consideration of their experience usually shows that top-dressing has done all that it reasonably could be expected to do—it has given additional feed. The farmer who disparages his top-dressing under such circumstances is in error ; it is he who has failed—failed in not linking the top-dressing with other measures which enable the extra growth that has been produced to be utilized properly.

Incidentally, the benefit from any other practice which, like top-dressing, begets increased summer pasture-growth may be restricted, or even eliminated, by inefficient utilization of the feed available.

One phase of this matter which warrants further consideration is that the results of poor utilization comprise not merely poor returns from the feed produced but also frequently include deterioration of the sward and a consequent decline in its productive capacity. This is because poor utilization of grassland usually involves both too light grazing in the late spring and summer and over-grazing in the winter and early spring—a type of grazing-management which tends to the progressive weakening of the species which produce feed early in the season and a strengthening of those which make late growth. In the mixed pastures characteristic of very extensive areas, this tends to the suppression of perennial rye-grass and the dominance of species akin to brown-top and sweet vernal. In short, there is growing evidence that generally conditions of soil and climate do not determine the botanical composition of a pasture so completely as is often believed, and that frequently the method of grazing is the real determining factor. While this generalization is not valid in respect to extremes of soils and climates when the influence of grazing management may be counterbalanced or masked by the greater influence of soil or climate, it is, nevertheless, so widely valid as to warrant more attention by farmers to the utilization of the growth of pastures. Production of feed is only one phase of farm-management, and if production of feed is not linked with suitable utilization it is certain that the fullest possible returns will not be obtained.

An important cause of this result is that poor utilization, apart from its harmful effect on the pastures themselves, leads frequently to stock being fed badly at two critical periods each year, whereas by good utilization an equal number of stock could be relatively well fed without increasing the total amount of feed available ; under poor utilization the supply of feed normally is not only wastefully excessive but also lacking in quality

in the early summer, while in winter and early spring the failure commonly is quantitative. This is primarily because 70 per cent. or more of the feed directly available from grassland is produced during the spring and early summer. When utilization is not good a common result of this is the following of a half-way course or compromise in regard to the number of stock carried. This half-way course often brings about an unsatisfactory position both in the period of highest production and in that of lowest production—understocking in the former period, overstocking in the latter.

Utilization Relatively Neglected.

Rightly during recent times much thought and effort have been given to the task of increasing the production of grassland until on many farms the production of pasture-growth is more efficient than its utilization. A most important feature of the position is that many farmers do not realize that their utilization is relatively inefficient in the light of current knowledge.

One of the principal causes of poor pasture-utilization is the allowing of the growth to become too mature and stemmy during spring and summer. The coarse stemmy growth is poor in three characteristics in which feed suitable for butterfat-production and for fat-lamb production requires to be good—the stemmy growth is poor in milk- and flesh-forming compounds called proteins, poor in mineral matter required for milk-and bone-formation, and poor in digestibility. For long it has been well known that very unsatisfactory results come from grazing sheep on pastures of considerable length and maturity, and particularly in recent years has it been realized that the grazing of coarse stemmy pastures is similarly undesirable for dairy cattle. To some, these facts are so well known that the statement of them may seem scarcely worth while. But they are important facts, and thousands of farmers continue to ignore them in their farm practices.

Means to Good Control of Pastures.

Commonly the avoidance of excessive stemminess or maturity of pasture-growth calls for the adoption of two complementary practices—systematic grazing and ensilage.

On many farms the essential steps in systematic grazing are the following simple ones: (1) Rapid grazing of individual fields by relatively heavy stocking so that each grazing period is usually of from one to three days; (2) subsequent "spelling" of the fields sufficient to again give the amount of feed required for the grazing period already specified, and this without punishing either stock or swards.

Often reasonably good grazing-management can be secured on farms subdivided into from nine to twelve paddocks exclusive of specially small paddocks used by pigs, calves, &c.

To enable successive grazings to take place at a suitable stage of growth it becomes necessary from time to time to omit from the grazing any paddocks in excess of those needed to meet the current feed requirements of the stock. It is the omitting of these paddocks that provides the material for ensilage, for as the season progresses usually more paddocks are dropped from the grazing than can be handled satisfactorily in haymaking.

The needs of the position may seem so obvious and simple as to make it somewhat surprising that they are so often neglected in practice.

Surely it is fortunate that ensilage, one of the most effective means of avoiding badly controlled grazing of pastures in late spring and early summer, is also one of the most economical ways of providing for better winter-feeding of stock.

Usually ensilage should be supplemented by some haymaking, partly because when any good haymaking weather is experienced haymaking may be just as efficient as and less laborious than ensilage, and partly because hay is more suitable as a complementary feed to roots than silage.

Control of pasture growth in spring and summer is facilitated by grass-harrowing, which, by evenly distributing stock droppings, assists in eliminating patches of coarse rank growth. Further information about the methods of effective grazing-management at this season may be obtained from local officers of the Fields Division.

Two important matters relative to ensilage that may need attention at this season are—(1) The closing-up of suitable pastures as discussed in last month's notes; (2) the construction of pits and trenches, which minimize wastage of material and lessen the amount of labour and equipment needed. Most farms contain suitable sites for trenches, which are essentially shallow pits and which usually can be made with little or no direct outlay.

There should be no avoidable delay in the closing of fields for ensilage. A common error is the making of silage at a later date than is desirable. An important respect in which ensilage is superior to haymaking is that silage usually may be removed early enough to allow of the development of a substantial fresh leafy aftermath before the advent of the customary dry summer period, during which such an aftermath is likely to be particularly valuable.

Further, the material used in early ensilage is likely to be less stemmy than that used in late ensilage, and reduction in stemminess of the material tends to corresponding improvement in quality of the silage—the original material itself is more digestible, and with it the high temperatures of curing which lead to loss of digestibility and of feeding-value generally are more easily avoided.

Frequently it is profitable to dress fields with superphosphate just before closing them for hay or silage, particularly if the fields have not been top-dressed during the preceding twelve months.

Real Value as Basis of buying Seeds.

It seems such simple common-sense to buy comparatively expensive and important lines of seeds on the basis of their content of live seeds of the sort to be sown that it is quite surprising that probably the majority of farmers buy their seeds in what may be termed a "blind" fashion. Farmers should certainly consider it of some significance that seldom can they sell their seeds really advantageously in a similar fashion, and, further, if they are offering really good lines of seeds, they do not desire to sell them in such a fashion — they have nothing to hide, and they desire the prospective purchaser to have dependable evidence of the intrinsic worth of what they are selling. It surely would be strange if this did not operate both ways. The two main matters that seem to be ignored by farmers are—firstly, that the appearance of most seeds is a very incomplete indication of their real value, and, secondly, that farmers, by taking simple suitable steps at the opportune time, may obtain free of cost from the Seed-testing Station of the Department of Agriculture all the information they need about the purity and germination capacity of any lines of seed they contemplate using. In this connection it should be kept in mind that certified seed is not necessarily of good germination or purity, and as certified seed usually is relatively expensive it is particularly advisable to obtain information about the purity and germination of certified seed—exact information is readily available, as it is supplied officially to the owners of the seed at the time of certification.

Forage Crops.

Often satisfactory provision for supplementing the feed directly available from pastures during the critical periods of scant grass-growth cannot be obtained with sufficient certainty by depending upon ensilage and haymaking alone. In dairying the provision of adequate supplies of highly digestible feed in the latter part of the summer is particularly important.

Just how important it is may be gauged by comparing the butterfat-production of 1936 with that of 1935. Because of differences in the seasons, in 1936 there were unusually good supplies of digestible feed in February, whereas in 1935 such supplies were poorer than usual. In February, 1936, the value of the butterfat produced was approximately £500,000 greater than that produced in February, 1935. As the total number of cows milked was approximately equal in each season, and there was no material difference in the composition of the herds, this difference in butterfat-production gives a striking illustration of the influence of feeding.

In dairying, the feed available directly from pastures often becomes inadequate or unsuitable at an earlier date than many seem to realize; frequently such feed is failing shortly after Christmas as a ration for reasonably good dairy stock, although it may suffice for stock of low production. It is relatively easy to rectify this weakness in late January and in February, but it is not so easy to remedy the weak feed position that occurs a little earlier. Fresh leafy growth such as the aftermath from ensilage or the growth from a stand of lucerne is likely to be very useful at this period. If a sufficient supply of such growth is not assured it is usually advisable to sow in October an area of quickly maturing soft turnips, such as Purple Top Mammoth, for use early in the New Year. The yield from such a crop may be somewhat small, but against this must be set the fact that it is specially serviceable in maintaining the production of butterfat until other suitable feed becomes available.

For the winter, crops such as mangels, carrots, swedes, and kales, including chou moellier, are often desirable in addition to silage and hay.

Thorough preparatory cultivation is extremely desirable in all cropping operations. Each year provides much evidence that the possible returns from judicious work and outlay in respect to other phases of cropping are far from fully obtained because of inadequate cultivation.

At times chou moellier has been sown with good results in October, when it may provide feed towards the beginning of February. Later sowings may quite well be made to give feed for use in the autumn and winter. Chou moellier calls for high fertility—it succeeds on soil of the type required for success with cabbage. Hence, if it is desired to grow chou moellier on inferior soils, their fertility should be improved—farm-yard manure being an effective dressing for this purpose. Chou moellier at times replaces swedes with advantage on land which tends to be too wet in winter for the satisfactory feeding-off of swedes. Chou moellier is so resistant to the attacks of club-root, although it is not immune, that it succeeds on land so badly infected with club-root that turnips, swedes, and rape are destroyed on it. A suitable sowing is 1½ lb. to 2 lb. of seed an acre sown broadcast or ½ lb. to ¾ lb. an acre in drills 2 ft. to 3 ft apart. On good land chou moellier usually responds profitably to a dressing of 2 cwt. to 3 cwt an acre of superphosphate—a dressing which on poor land generally may be increased with profit. Chou moellier has been used successfully for cows, sheep, pigs, and poultry; it is not looked upon as suitable for fattening lambs after the manner of rape.

The Potato Crop.

In many districts the main crop of potatoes should be sown in October. The potato fares best on a friable soil of high fertility, and partly because of this the crop should be grown, if possible, on land recently ploughed out of old pasture so that the supply of organic matter which begets friability and fertility may be at its maximum

Great care should be taken to obtain seed which is free from disease. The most serious type of disease—virus—cannot be detected by examination of the tubers. On this account the only safe course generally is to use certified seed—*i.e.*, seed that has been passed under the official system of certification which is administered by the Department of Agriculture, and

which attaches much importance to the amount of virus in the foliage of the parent crop at the time of field inspection. It is known that virus passes from the foliage into the tubers and that the run-out condition of much seed offering is due to virus, for which there is no known effective direct control. In cases in which one line of seed potatoes has given a yield of table potatoes four or five times as great as that from another line of the same variety and under identical conditions, investigation has shown that the large difference in yield was due essentially to virus trouble.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Cultivation.

In all localities where soil conditions permit, cultivation should receive special attention, and every effort should be made to reduce the soil to as fine a tilth as possible. There are but few orchards where, without detriment, cultivation can be dispensed with. An important point which must not be lost sight of is that the season's crop largely depends on the condition in which the soil and trees are kept during the early summer months.

Fertilizers.

It is not too late to apply nitrogenous and phosphatic fertilizers, but the application should not be further delayed.

Grafting.

Grafting should be commenced this month, and in most districts may be continued throughout October, but it is important to remember that to obtain the best results the scions for grafting must be kept in a dormant condition. The buds on the scions should be healthy and plump, and care should be taken that only wood free from disease is used.

Spraying.

Spraying must not be neglected, otherwise the majority of the fruit crops will be unfit for market. Usually at this time of the year showery weather may be expected, which is favourable for the germination of the spores of all fungous diseases.

A close watch must be kept for powdery mildew. Apple and pear trees should be sprayed at petal-fall with lime-sulphur (polysulphide content 15 per cent.) 1–120. To this may be added 2 lb. of colloidal sulphur per 100 gallons. In addition to controlling powdery mildew, this mixture also controls black-spot on apples and pears, providing the spraying programme as set out in the orchard notes for the last month has been carried out.

Where leaf-roller caterpillar is prevalent it will be found advisable to spray apple and pear trees at pink tip with 1½ lb. arsenate of lead powder to 100 gallons of water. This destroys a large number of the first hatching, and therefore makes it more easy to control throughout the remainder of the season Quite a number of growers neglect to spray for this pest until the fruit is damaged, and in the majority of cases the grub is then protected by fastening a leaf to the apple, or rolling and fastening the leaves loosely together with silken threads into a nest in which they feed.

For the control of codling moth the trees should be sprayed at petal-fall with arsenate of lead powder, 1½ lb. to 100 gallons. This may be combined with lime-sulphur, providing that 3 lb. hydrated lime is added to the mixture in order to assist in preventing leaf scorching or damage to fruit. This should be repeated at three-weekly intervals.

For the control of leaf hopper the trees should be sprayed while the hopper is in the nymph stage, with nicotine sulphate 1–800. This should be repeated in from ten to fourteen days. If the nicotine is not combined with lime-sulphur or arsenate of lead, 3 lb. of soft soap should be dissolved and added.

Ten days after petal-fall apple and pear trees should be sprayed with lime-sulphur 1–180, plus 2 lb. of colloidal sulphur per 100 gallons, to prevent powdery mildew and black spot. This to be repeated at ten-day intervals.

Stone-fruit trees should be inspected carefully for green and black aphis, and immediately either or both of these pests are observed nicotine sulphate (1–800 plus 3 lb. soft soap) should be applied, and repeated in from ten to fourteen days.

For the control of brown-rot spray at fruit set with lime-sulphur (1–80 plus 3 lb. colloidal sulphur), to be repeated in three weeks.

—*B. G. Goodwin, Orchard Instructor, Christchurch.*

Citrus-culture.

Disease.—If weather conditions have been favourable (that is, excessively moist) to the development of citrus brown-rot, those growers who have not applied a good covering of Bordeaux to their trees would be well advised to again spray thoroughly now with the 3–4–50 formula. An application at this time serves a dual purpose, as apart from being a protection from brown-rot it also serves as a protection to leaves and shoots against infection from verrucosis lesions on mature fruits, leaves, and shoots. Although the main spraying for the control of this disease comes later, the above - mentioned application should not be omitted in groves where verrucosis has been prevalent during the past season. In the use of Bordeaux mixture some growers still adhere to the old formula of 4–4–40, and while in itself there is no harm in this, there is a possibility of uncertainty and confusion arising in the minds of some who see one formula in one publication and a different one in another. To avoid this, the 3–4–50 formula has been adapted generally as standard for all plants in foliage. The main point for growers to keep in mind is not so much the strength of the mixture but the thoroughness with which it is applied combined with correct timing of the application, which all count in securing successful control.

Pruning.—Now that the danger of frosts is practically over, pruning may be attended to. It is not suggested that the pruning of citrus is a regular and extensive task similar to that for deciduous trees, but undoubtedly in many of the older groves there is not sufficient pruning being done. The removal of dead and diseased wood should be undertaken as a matter of course. Efficient growers do not allow this to accumulate in their trees. Apart from wood injured or killed by frost much of the unthrifty wood is pruned out at picking-time. The cause of many of the dead spikes which lead to branch-rubs and scratches is faulty technique by pickers, who often snip off a lemon close to the button and leave on the tree a weakly stub of wood which ultimately dies ; if this is not removed it is a potential source of damage to maturing fruits. The approved method of picking fruit is to make the first cut back into healthy wood, and then with the second to trim off the twig from the fruit close to the button. But this, however, is mere routine work. Whether a tree requires special attention by way of a thinning-out of the leaders and a cutting-back of the laterals can be determined only by careful observations made during the course of other orchard operations, particularly picking. For instance, where lemon-trees are not " sizing up " their crop at a normal rate and are colouring their fruit before it is large enough for picking, they may need reinvigorating by hard pruning. It may be necessary to use the saw, and to remove some of the main limbs in order to obtain the desired vigour. Just as with trees of other kinds of fruits, many of the citrus trees are

furnished with too many leaders. These are often so crowded together that it is impossible for a good supply of fruiting laterals to develop. Trees readily fill up the open spaces arising from the thinning out of leaders. Such pruning not only causes the remaining leaders to become stronger, but also is the means of causing a large number of thrifty laterals to be developed, and these in due course should carry heavy crops of good fruit.

Planting Trees.—The most suitable time for planting trees must be determined by the individual grower after due consideration to local conditions. Where it is intended to plant in the early spring, planters should delay until the danger of frosts and of cold winds is over. It is advisable that late spring planting should be done while the soil is still moist to enable the trees to become established quickly without suffering a set-back due to drought. The distance apart at which the trees should be set is at least 25 ft. for lemons and 20 ft. for oranges on the square system. The holes should be prepared before planting-time. The soil should be worked up finely over a wide area and to a good depth. Some organic matter such as cow-manure, sheep-manure, or blood and bone at the rate of 4 lb. per tree should be worked well down and clear of the soil which is to come into direct contact with the roots. On arrival at the orchard the trees should first be cleared of all packing materials and then " heeled in " if planting is not to be proceeded with right away. The roots should not be allowed to become dry. Just prior to planting, the roots should be puddled in mud of a thin consistency and then placed in position in the hole in the proper alignment. The roots should be spread out in a natural position, fine soil should be packed in amongst them by hand in order to separate the roots, and then the remainder of the soil should be spaded in and tramped down firmly. It may be advisable to water occasionally so that the young trees do not suffer from lack of moisture In cases where trees have been in nursery rows in the orchard they can be lifted with the soil intact around the roots, transported on a sledge to the holes, and planted without serious injury to the roots or set-back.

If the trees arrive in good condition, pruning back of the shoots is unnecessary, but if they suffered in transit a little cutting back and defoliation may be necessary. Where the shape can be improved by a judicious cut or two this may also be done, but it must be borne in mind that with citrus trees one cannot always be sure of getting growth from each and every bud. Little or no pruning should be done to citrus trees until about the third year, when an attempt should be made to develop an open framework of about five sturdy leaders.

Shelter.—Where, in spite of all warnings given to the contrary, trees have been planted out without the provision of adequate shelter-belts, some temporary expedient should be adopted, such as the use of scrim supported by stakes, light brushwood around each tree, or the planting of maize in a couple of rows 6 in. apart. The stalks of the maize remain well into the winter and afford considerable protection.

Cultivation.—This may now be proceeded with. Underneath the spread of the trees the weeds should be removed and the ground lightly hoed. Care should be taken, particularly when a push hoe is used, to see that no damage is done to the trunk of the tree, as any injury is likely to afford entry to bark-blotch organism. The cultivation of the lands between the trees should be done by plough, discs or rotary hoe, according to the method best suited to the district and the implements available. In a citrus grove the initial spring cultivation is often delayed later than that with other fruits, particularly where the cover crop has been sown late in the summer, in order to avoid the necessity of carrying out the main picking-operations in long growth, which on a dewy morning remains wet for a considerable time after picking is possible. With cultivation, as with other operations, the individual grower must use his judgment. Cultivation of the soil in the early summer, and an occasional harrowing to keep the weeds (moisture

robbers) down in the hot summer weather, should be the rule. However, as citrus trees, to maintain their vigour, require organic matter or humus, and excessive cultivation tends to destroy it, this operation should not be overdone, particularly on light sandy soils.

Harvesting.—The rush of other spring work should not be allowed to interfere with the regular picking schedule. A watch should be kept for fruits which have failed to " size up " but have become tree-ripe. These should be removed forthwith.

—*A. R. Grainger, Orchard Instructor, Tauranga.*

POULTRY-KEEPING.

Overcrowding.

A WEAKNESS that is becoming rather apparent on many plants is that dangerous practice of overcrowding. This fault has been more noticeable, especially during the past year or two, not only on some more or less inexperienced persons' plants but also on some plants run by poultry-keepers with a number of years' practical experience.

Unfortunately, cases of severe losses from colds, roup, &c., have come under notice during the past year, and in quite a number of those cases investigation has shown that the primary cause of the trouble was overcrowding in poorly-ventilated houses. Unless warning is taken and efforts made to check this growing evil, it is feared that some poultry-keepers may have serious losses by trying to rear more stock than the number for which they have accommodation. To begin with, a mistake is at times made by crowding too many eggs into an incubator, or the crowding of too many incubators into a room which is insufficiently ventilated

The manufacturer of the incubator has made his machine to hold a maximum number of eggs, and ventilation has been arranged for that number, but if the incubator is overcrowded it can hardly be expected to give the best results It is quite possible that more chickens may actually be hatched from an overcrowded or a refilled machine, but experience has shown that a better class of stock is hatched and a larger percentage of good stock is reared from incubators that are operated a little below rather than above the capacity set down by the maker.

Again, quite a number of troubles and of inferior birds from artificial brooding are due to overcrowding, and the same conditions as mentioned in the preceding paragraph may also apply with regard to the number of day-old chickens placed in such brooder.

As the chickens grow it is advisable to see that they are given plenty of room and more fresh air at night, and that they are graded up regularly.

In practically every hatch there are to be found some birds that do not come on as well as the majority, being shy, more nervous, or having less confidence than the rest, and these are often harassed by the stronger members of the brood, with the result that they do not get sufficient food.

When chickens are overcrowded many culls are often obtained, and untold damage is likely to be done, as the general vitality of the lot is likely to be lowered, and thus the birds made more susceptible to disease. If at all possible it is economical to have a spare brooder on hand and use it for grading-up purposes, as the extra quality and number of birds raised when a regular system of grading-up is practised more than pays for the little extra expense and trouble.

At times when growing stock are overcrowded there results too rapid development, with the result that the birds' constitution, instead of being built up, is weakened, and they are unable to withstand the strain of a long laying period.

Too many poorly-reared pullets are to be seen, many of which do not come on to lay until well into the " flush " season. It is doubtful whether

pullets that do not start to lay until July ever repay what it cost to rear them, and their keep. The rearing of a large number of good pullets successfully is a highly specialized business that requires a great deal of experience, close attention to every detail, and one must ever be on the watch for any sign that indicates unsuitable environment, especially night conditions. The overcrowding of laying-houses has often been the cause of poor egg-production, false moults, or colds amongst stock.

Some poultry-keepers are under the impression that by placing an extra perch in a house that suitable accommodation is being provided for extra birds, but such a practice does not always prove successful. A house 20 ft. long by 20 ft. deep is large enough for 100 laying hens, and one 14 ft. long by 16 ft. deep for 50 birds; in other words, each bird should be allowed 4 sq ft. floor space. Experience has shown that where less than 4 sq. ft. are allowed each bird the results have not been as good as with the larger space.

When a house is overcrowded it is almost sure to become damp, and dampness in laying-houses must be avoided at all costs. It is well to remember that birds spend a good deal of their time on the perches; therefore, conditions in their roosting quarters must be such that plenty of fresh air is available and a dry atmosphere is provided.

There is a growing tendency amongst successful poultry-keepers not to run more than fifty laying hens together. A little overcrowding during any one stage may not be very noticeable, especially to the inexperienced person, but if the same mistake is made each year there is sure to be a gradual deterioration of the general quality of the flock. Now that the hatching season is here again it is well to consider the great advantage of hatching only the number for which there is ample accommodation, and of aiming for quality and not quantity

Colds.

A careful watch should be kept at all times on the stock for the first sign of colds. If dust or dirt is seen adhering to the nostrils of a bird it is usually safe to say that that bird is suffering from a cold, and it should be separated from the rest. If possible, the cause should be found: the cause is often compelling young stock to roost in crowded or badly-ventilated houses, and such conditions should of course be corrected. The mouth and nostrils of the affected bird should be washed with warm water containing one teaspoonful of common salt to a quart. The secretion should be removed from the nostrils. If the sides of the head under the eyes are gently massaged before and after it is washed, the secretion is loosened.

For a poultry-keeper living near the sea fresh sea-water is of value for bathing a bird's head if a bird is suffering from a cold. After the mouth and nostrils have been washed as suggested, it is advisable to disinfect those parts with a solution of half hydrogen peroxide and water. All affected birds should be given Epsom salts, about one teaspoonful to each three birds. This can be given twice in a week by being dissolved and mixed in the mash.

Natural Incubation.

September is looked upon as the best month of the year in which to hatch out chickens, especially those of the light breeds. Though many farmers may find it difficult to get broody hens until a little later, every effort should be made to get all chickens hatched before the end of October at the latest, as late-hatched stock does not do well.

Where only a few clutches are required, and if one is not altogether satisfied with the production from the stock on hand, it will be sound economy to spend a few shillings on the purchase of a sitting or two of eggs from a good strain. It will be found that there is as much difference between the laying ability of pullets hatched from stock that have been bred for egg-production and the mongrel-bred pullet as there is in speed between the average hack and a thoroughbred horse.

As many chickens are lost each season from the ravages of insects, it is advisable to see that all broody hens are dusted in order to rid them of insects before they are set. It is not a good practice to set hens in the fowl-house as they are likely to be disturbed by other birds. Better results are usually obtained if the broody hens are set in a coop made for the purpose, and if such coops are placed some distance away from stables or other buildings rats are not so likely to be troublesome.

The hen should be confined to the coop for at least a few days after the hatch comes off, for often there are one or two chickens that hatch out a little later or that may not be quite as strong to start with as the rest, but if such chickens obtain warmth under the hen for a day or so they develop into strong healthy birds, whereas if allowed to roam with the stronger chicks they in many cases are lost. There is no doubt that the easiest way to rear a few chickens is with the mother hen, and given proper facilities the majority of hens make a good job of the business If at all possible the coop should be placed on fresh ground away from where adult fowls have been running.

It is advisable to feed the chickens at set times: the first feed should be given as early as possible in the morning, and the last just before dusk. It is a mistake to leave wet mash before chicks as it is likely to spoil their appetites.

Milk in all forms is one of the best feeds for growing stock, as it is so easily digested and is a great growth-promoter

Whether the chicks are being reared with a hen or in a brooder it is well to keep up a regular supply of finely-cut succulent green feed A person will never regret giving chickens, after the first three or four days, a good variety of green food Chicks that have had an abundance of green food are in a much better condition to resist disease

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Artificial Feeding.

As advised previously, a strict watch should be kept on the food-supply. As the spring advances this matter becomes of paramount importance. On no account is it advisable to allow the stores to dwindle. The queen's laying-powers are to a large extent automatic—as she is fed so she lays—and when food is abundant brood-rearing is in proportion. Artificial feeding is invariably stimulating, and once undertaken must be carried out regularly and systematically. It is poor policy to fill a hive with brood and then leave it to starve. Spring losses are usually due to lack of stores, and are therefore preventable on the part of the beekeeper. It is advisable to feed sugar syrup only, in the proportion of two parts of water to one of sugar, and to place it in the feeder while slightly warm

Providing Water.

In the absence of a natural supply, water should be provided. Bees require a good deal of water for brood-rearing throughout the whole season, and it often happens that numbers of bees are lost if water is not close at hand. Moreover, bees often become a nuisance at cattle-troughs and round domestic supplies. Where a large number of colonies are kept it is imperative that the beekeepers see that the bees are well supplied

Many contrivances are used for the purpose of supplying water. "Simplicity" feeders make excellent vessels for containing water, but they require to be filled frequently and occasionally cleansed. A good contrivance is a kerosene or petrol tin used as follows: Having thoroughly cleansed the tin, punch in the bottom a hole about the size of a sixpence;

through this hole pass a piece of clean rag so that the water falls a drop at a time. Under the tin a container may be placed to catch the water, and this, if filled with sand, affords an excellent watering-place for the bees. The supply can be regulated according to the requirements of the apiary. Bees prefer to take water from damp situations, and they may often be noticed in numbers sucking water from the ground where there has been any overflow. Containers should be placed in a sheltered spot in the apiary.

Foul-brood.

At all times when examining the combs a strict watch should be kept for symptoms of disease. Beekeepers should never lose an opportunity of acquainting themselves with foul-brood in all its stages. At this season, if isolated capped cells are discovered in frames which contain no other brood, these should be treated as suspicious, and subjected to the test for foul-brood. If on opening the cell, when a sharp-pointed piece of stick is inserted, the dead imago can be lifted out complete in form, the beekeeper may conclude that if dry it is a case of starvation and if moist of chilled brood. If, however, the contents of the cell adhere to the point of the stick in a ropy ill-smelling mass, it may be concluded that the hive is diseased.

There is perhaps no surer indication of the presence of foul-brood in the hive than the objectionable smell of the decayed larvae. Beekeepers who once recognize this odour will have no difficulty in detecting the disease in that stage. The last and most difficult form of foul-brood is the dry stage, and in this form it has baffled beekeepers of long standing. Only a careful examination can reveal its presence. The diseased larva, having dried to a scale, adheres to the lower side of the cell, and can be removed by scraping with a sharp-pointed instrument. If the aforesaid isolated capped cells on being opened appear at the first glance to be empty, they almost invariably yield a scale if examined, and the hive should be marked for treatment.

There is a deeply rooted notion among beekeepers that foul-brood can be detected outside by the odour, and inexperienced beekeepers are often misled by this statement. However, where the glue-like smell is noticeable from the outside of the hive at a distance of a few feet it may be concluded that the colony is diseased beyond redemption. Fortunately such cases are rare.

Apiary Locations.

Perhaps there is no more important question for the beekeeper than location. Upon his ability to select a suitable district in which to start beekeeping depends his future success. There are few districts in the Dominion where bees cannot be kept in small numbers, but successful establishment of a commercial apiary largely depends upon the beekeeper's knowledge of the nectar-secreting plants. It is generally recognized that the main nectar-flow in New Zealand is produced from white clover and catsear, but it is a distinct advantage if the apiary is established in a district near patches of native bush or where the golden willow is abundant. Most of the indigenous trees and willows flower early, and the nectar from these sources is very valuable to the beekeeper, as it provides ample stores in the spring.

In districts where the beekeeper has to depend entirely upon white clover a careful watch must be kept on the stores, and very often artificial feeding has to be carried on until the appearance of the clover-bloom. This is often expensive, and usually can be avoided by selecting a site where at least a moderate spring flow may be anticipated. The rich dairy pastures of both the North and South Islands, and localities where cattle-raising is carried on extensively, provide suitable sites for commercial apiaries, while country which is used for sheep-grazing is generally not profitable, as the clover pasture is usually eaten bare. Instances have come under notice where abnormal crops have been secured in purely sheep-country, but they

are too infrequent to be taken into consideration, and consequently this class of country should be avoided. Essentially the main requirements are feed and shelter, and if the apiarist is fortunate enough to locate his bees in a position where there is an abundant supply of nectar-secreting plants good shelter can be provided easily.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

OCTOBER is not the least important month of the planting season. Besides completing the sowing of hardy main-crops, the following half-hardy crops are started in most districts—kidney beans, gourds, sweet corn, tomatoes, egg plants, and peppers ; also important are the seed-beds of savoy and red cabbage, cauliflower, broccoli, and kale sown for planting out two or three months later to mature during autumn and winter. These crops provide a valuable and varied supply during the summer, autumn, and winter seasons.

To obtain the best results from the half-hardy crops a rich free loam and well-sheltered position is required. Beans and gourds are among the oldest of our vegetable crops The broad bean, *Vicia faba*, is a hardy native of Europe, which in ancient times was extensively grown ; during later years it has been almost entirely displaced by the kidney bean, *Phaseolus vulgaris*, which with so many other useful culinary plants was introduced from South America. Being useful in either a green or dried state makes the kidney bean available over a long period, and thus a vegetable of the first importance. Land well supplied with humus should be given a good dressing of phosphates, and, when the crop is up, a light dressing of nitrate of soda as required The seed is sown 2 in. or 3 in. deep, 3 in or 4 in. apart, with 18 in. to 30 in. between the rows

The gourds have long been esteemed in warm and tropical countries everywhere, especially species of *Cucumis*—cucumbers and melons—and *Cucurbita*—pumpkins and marrows. The marrow, said to be a native of Persia, is the hardiest, and, used in a green state during summer, is an attractive vegetable. The keeping-quality of pumpkins makes them of value in affording variety for winter use. And in many parts of the country the warm season is too short to produce a good crop of cucumbers and melons outside, unless every precaution is taken to start the crop as early as possible. Excellent musk and water-melons are grown in the warmer districts here, and they are crops which could doubtless be extended with advantage A rich light moist soil and good shelter are the main essentials

Sweet corn is a variety of the field corn, *Zea Mays*, being distinguished by its high sugar content in its early stages of development and by its translucent kernels when dry As a summer vegetable it is becoming increasingly popular. It is drilled 3 ft. to 4 ft. apart, and the plants are thinned to 8 in to 10 in apart in the drills. Golden Bantam is a popular early dwarf variety, and Stowell's Evergreen and Country Gentleman are vigorous late varieties that are popular A continuous supply is obtained by sowing early and late varieties ; or by sowing an early variety at intervals of two weeks or three weeks. To obtain it in best condition, it should be gathered so soon as the silk withers, as the amount of sugar decreases as the kernels harden.

Egg-plants and red peppers are of tropical origin. They are the last to be taken from the shelter of the frame, and planted out only when warm weather is practically assured. The increasing quantities reaching the market during summer indicate the greater interest taken in these attractive and useful culinary fruits. They are grown satisfactorily only in the warmer localities.

Towards the end of October tomato-plants are planted outside in many districts. In the cooler localities early November is often soon enough. As a good crop can be expected only from good plants every effort should be made to be sure the plants are suitable. Good plants are of a satisfactory strain, young and sturdy, well developed, free from disease, and thoroughly hardened off. In well-prepared ground such plants come away with little trouble under ordinary conditions. A generous dressing of phosphates, usually applied in the form of superphosphate and finely-ground bonedust, and a moderate dressing of sulphate of potash are the chief fertilizer requirements. If the land is rich in organic manure the potash dressing should be correspondingly increased. Under glass this crop is now reaching a stage when the growth is of such dimensions that the amount of air in the house is much reduced, while at the same time the volume of vapour from transpiration is greatly increased. As a result a humid atmosphere is created which often reaches high temperatures—conditions which are most injurious to this crop and should be avoided by providing ample ventilation: in sheltered warm localities this requirement is often very considerable especially if the climate is also generally humid. By such attention at all times now flowers and foliage develop the substance and vigour to properly function and be less likely to suffer from leaf mould and other diseases. In most districts ventilation also at night generally now is necessary.

Small and Sundry Fruits.

Tree tomatoes, Cape gooseberries, and passion vines may now be planted out. These require a relatively warm position to obtain the best results; they are natives of Peru or Brazil *Cyphomandra betacea*, as the tree-tomato is called by botanists, is a semi-shrub with large soft leaves and grows here to a height of about 6 ft Its bronze foliage is quite ornamental, as also are its large smooth oval fruits, which ripen in mid-winter. These are generously produced by plants growing in a rich moist loam and well-sheltered position. There is a fairly steady demand for the fruit, which is suited to culinary purposes and makes an attractive dish under good management A small planting only is usually made, the plants being set about 6 ft. apart.

The Cape gooseberry, *Physalis peruviana*, var. *edulis*, is well established in favour, and might well receive attention for commercial cropping by those who have light land in a warm position. To ripen the full crop before autumn frosts intervene good plants should be set out early and kept growing steadily. A good dressing of phosphates and some sulphate of potash suit them best. The plants may be set 3 ft. apart with 6 ft. between the rows where no support is given. The Cape gooseberry is a perennial herbaceous plant, cut down to the ground by frost in autumn, but when the tops are cleared in early spring and a good dressing of fertilizers is cultivated in they will grow away and produce a second and even a third crop.

The passion vine, *Passiflora edulis*, has received a great deal of attention during recent years, sometimes perhaps too much, but the unique flavour and fragrance it imparts to salads confers a distinction that always makes this fruit popular for that purpose. It is also to be remembered that six or seven years is the extent of the life of a plantation, so that any overplanting which may have been done in some localities is not a very permanent feature.

Although not exacting as to soil conditions, good land is necessary to produce full crops each season over the whole life period of the plantation. Good drainage and shelter are also essential. To enable spraying for the control of disease to be done effectively it is essential that the vines be trained and pruned annually to avoid an accumulation of old unnecessary growth and to maintain a good supply of the new laterals on which the crop is borne.

Plants may be set now 10 ft. apart, at the base of stout stakes and posts standing 5 ft. out of the ground; with a distance of 9 ft. between rows it takes 480 plants to the acre. Two No. 8 galvanized wires, one each side

of the top of the post, and another 3 ft. below them, should be made fast to well-stayed strainer posts, tightened and secured. By stopping laterals after a few leaves have formed growth is concentrated in the leader, which when the top of the post is reached is stopped to make it break into side growths, which are trained along the top wires, and form the bases from which the fruiting-wood springs. Where it is desired to plant passion fruit next season the seeds from selected fruit may now be sown in boxes, pricked out into other boxes later, and grown on in sheltered cradles until required for planting out.

Land for autumn planting in strawberries may now be planted in an early vegetable crop and thoroughly cleaned so that it is ready when required. Where it is intended to plant bush fruits next winter, a main crop of vegetables may be grown now, and a similar routine followed, which secures adequate preparation with economy.

The Homestead Garden.

Few gardens in this country are complete without a liberal display of daffodils to supplement the flowering shrubs during the winter and spring of the year. Rather large groups, each composed of a single variety, planted in the foreground of a shrubbery are perfectly happy with little attention for a few years if they have the vigorous constitution necessary for garden planting. Some of the older varieties have the necessary qualities to fill these requirements admirably, but a great many have been entirely superseded by the fine new seedlings which have been introduced during recent years These now form a very long list, and, while most of them have the quality which warrants registration, a very much smaller number have, in addition, the vigour which is necessary to warrant them being used for display in the garden borders To assist planters in making the best selection for this purpose the Royal Horticultural Society has concluded a three-year trial in their Wisley garden and recently published the result in the July number of their Journal Of the 262 varieties of the newer kinds under trial the ones mentioned below are among those which received the higher awards of merit. The method was to plant twenty-five bulbs of a variety in a clump, the clumps being distributed through a shrubbery border as in an ordinary garden, and to keep them under the supervision of a specially appointed committee. Varieties receiving awards carried from fifty to one hundred blooms in the third year

The large trumpet varieties were among the earliest to flower: those receiving the higher awards among yellow trumpets were Brandon, Decency, Solferino, Sulphur, Winter Gold, and Wrestler. Of the white trumpets Roxane and Pacific. In bicolor trumpets Mrs. E. C. Mudge

In the large-bright-cup section (Incomparabilis), Havelock, Ambule, Carlton, Garibaldi, Grenade, Helios, Jubilant, Killigrew, Lucinius, Red Defiance, Smeroe, and Yellow Bird And with a light perianth, Folly, Eva, Marian Cran, and Warlock.

In the short-bright-cup section (Barii), Dinkie, Nanny Nunn, and Ming.

In the section devoted to white, or whitish, cups large or short (Leedsii), Marmora and Tunis received the highest awards Others receiving good awards were Cicely, Grayling, Hera, and Mitylene.

Rock gardeners will be interested in the hybrids of *Narcissus triandrus* and *N. cylamineus*. Those of *Narcissus Jonquilla*, which always make a wide appeal with their grace and perfume, include Golden Sceptre, Lanarth, Trevithian, Aurelia, Hesla, and Yellow Prize.

In the section known as Tazetta or Poetaz it comes as no surprise to find Scarlet Gem received the highest award; the clumps bore twenty-six flower stems the first year and seventy-nine in the third year; with the variety Glorious as a very fine second.

Such variety trials are invaluable to planters. By planting the most suitable material in an understanding manner time and money are saved and good results are obtained without delay.

—*W. C. Hyde, Horticulturist, Wellington.*

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

BURNT BONES FOR LAYING-HENS.

G. H. M., Seddon :—

Are burnt bones of value to laying-hens ?

The Live-stock Division :—

Quite a number of poultry-keepers add a small quantity of ground or broken burnt bone to the grit or oyster-shell, which should be within reach of the birds at all times. The broken burnt bones are considered to be useful when hens are laying thin-shelled eggs.

BLOOD COMING FROM UDDER.

L. H., Willowbridge :—

In the milk coming from one quarter, a back one, of each of two cows blood occurs. Could you please inform me the probable cause of this condition ; whether the milk is fit for separation ; what treatment, if any, should be given ?

The Live-stock Division :—

The condition you describe is most frequently brought about by small blood vessels in the udder becoming ruptured owing to the great congestion of the udder with blood, after parturition. Other causes may be bruising of the udder in some way, rough milking by hand, or injury by means of the milking-machine. The act of milking naturally reopens the injury, and until this heals a varying amount of blood will come away, particularly with the strippings. Time alone will remedy the matter, though benefit will be derived by a very careful hand-milking ; do not strip right out ; cease stripping at the first appearance of blood. It is not advisable to put through the separator the milk, which, however, may be fed to pigs or calves without ill effect. With reference to further treatment of the cows, a drench composed of ½ lb. Epsom salts, ½ lb common salt, and 1 oz ginger to 1 quart of warm water may be given. If the case does not improve send a sample of the milk to the Officer in Charge of the Veterinary Laboratory, Wallaceville. If you do this the bottle for holding the milk, and also the cork, must be thoroughly cleaned and then boiled for ten minutes to ensure complete sterility.

UTILIZATION OF SUGAR-BEET.

W. E. P., Hunterville :—

Please describe the correct method of harvesting and feeding sugar-beet to dairy stock, and also its value as a food for such stock when used in conjunction with hay.

The Fields Division :—

The time to start lifting sugar-beet can be told by the yellowing or browning off of the lower leaves. Sugar-beet is deep-rooting and, consequently, very difficult to pull, but no information is available of any devices employed in New Zealand to assist in harvesting. In England special implements are used, although it is stated that the roots can be loosened by an ordinary plough, running a small furrow along the rows. The general treatment is much the same as for mangels, and the roots can be stored in a heap covered with straw.

As regards the feeding-value of sugar-beet used in conjunction with hay, such a combination would be more suitable for dry stock, as it is very deficient in protein. The feeding-value of sugar-beet is somewhat higher than that of mangels (although, incidentally, the higher yields and easier harvesting of the latter generally more than compensate) ; approximately 12 lb. of sugar-beet (dry matter 23 per cent.) equals 25 lb. of mangels (dry matter 13 per cent.) or 5 lb. of hay. A ration consisting of about 8 lb. of hay and 24 lb. of sugar-beet per head per day should suffice for maintenance, although, as mentioned above, there

is likely to be a deficiency of protein. The sugar-beet tops are of value, approximately 25 lb. of tops being equivalent to 40 lb. of mangels. They should be fed, however, only after being allowed to wilt for about a week.

RED-WATER IN STOCK.

R. E. C., Frankton Junction :—

Please advise about red-water, which is said to be prevalent among cows being fed on new grass.

The Live-stock Division :—

Certain farms and pastures are notorious for what is called red-water. This is especially true of pasture containing much cocksfoot, and in this country if the soil is of a peaty nature, or is badly drained swamp land, new grass may be associated with this disease, as also may green oats, but not so consistently. Turning cows on to turnips, especially if they have had a touch of frost, or on to roughage such as tall fescue, maize-stalks, and weeds, is conducive to this disease, especially when the cows have not had sufficient hay to make a reasonably balanced ration.

As far as is known from extensive investigation here, the disease is of purely dietetic origin, and is now not so prevalent, owing to animals being better fed and land being better drained and treated.

When this disease appears in a herd, usually several animals are affected, and one of the first symptoms noticed may be the passing of reddish-coloured urine. Animals go off their feed, look sick and dejected, and may suffer from diarrhœa or constipation, and they are very anæmic. In several cases the symptoms become more pronounced and animals may go down and be unable to rise, or they may stand with their heads down, shivering, breathing heavily, and unsteady on their legs. Death takes place in two or three days.

Treatment · Remove animals from feed they are on, give them good hay, and have them in comfortable surroundings. If thought necessary put covers on the sick ones and try feeding them with some crushed oats and bran and salt Give a ½ lb. each of Epsom salts and common salt dissolved in 4 lb. of black treacle and oatmeal gruel, milk, and eggs, &c , in very bad cases. There is no reason why you should not drench the cow with her own milk. After this, 2 oz. of common salt dissolved in two quart bottles of milk may be given daily as you think best, and discontinued when you wish, according to the progress made. A tonic may be given after. To endeavour to prevent this disease when feeding upon roots, allow a reasonable amount of hay and do not keep animals on the new grass too long. Change them frequently to different feed.

WEATHER RECORDS: AUGUST, 1936.

Dominion Meteorological Office.

NOTES FOR AUGUST.

THE month began with unusually widespread snowstorms raging over much of the country, and several days of cold frosty weather followed. Again, at the end of the month, there was a cold snap. The first spell did little damage since, after the 1st, the days were bright and sunny and the snow soon disappeared. In the second there were some losses of lambs, but the ground was too warm for pastures to suffer greatly. Between these two periods the weather was almost continuously mild and spring-like. Grass has grown very quickly for the time of year, and trees, flowers, and shrubs are in an unusually advanced state. White butterflies made their appearance in many districts, and other insects were active. Birds are already showing signs of mating. Stock are doing well, and the lambing-season has, so far, been a good one. Feed is plentiful. In western districts and Marlborough a spell of dry, sunny weather would be now welcomed.

Rainfall.—Most of the east coast of the North Island and a strip extending across from Hawke's Bay to Wanganui had less than the average rainfall. The same was the case with areas about the borders of Canterbury and Marlborough and Canterbury and Otago The rest of the country had more than the average Over the western half of the South Island the falls averaged at least double the normal for August.

Temperatures.—The month was one of the warmest Augusts on record. Temperatures were everywhere above normal, the average departure being over 2° F. Following the snow at the beginning of the month some severe frosts occurred.

Sunshine.—The total amount of bright sunshine was slightly above normal over most of the eastern districts of the South Island, but elsewhere was below. Unusually cloudy conditions were experienced in all western districts. Napier had 169·6 hours and Tauranga 161·4.

Pressure Systems.—Cold, strong southerly winds were blowing on the 1st, and snow was falling in many places, especially in eastern districts, following the passage eastward of a deep depression. The snow lay to unusually low levels, about Wellington particularly. Anticyclonic weather with sunny days and sharp frosts at night then prevailed until the 4th.

From the 5th to the 17th a series of westerly depressions continued to cross the southern portion of the Dominion. Winds from between north and west persisted and were often strong. There was frequent heavy rain in western and northern districts, but comparatively little east of the ranges. Temperatures were remarkably mild. On the 7th, after the passage of the first depression of the series, snow was widespread on the high levels.

An anticyclone then crossed the northern part of the country, and, after moving south-eastwards, became very intense and almost stationary, with its centre in the neighbourhood of Chatham Islands. It was not until the 26th that the anticyclone finally began to give way. Northerly winds and warm weather prevailed most of the time. There were general rains with many heavy falls, though districts from Canterbury southwards escaped lightly.

On the 28th a depression appeared over the Tasman Sea. Developing into a deep cyclone, it crossed the South Island on the night of the 29th. This storm caused the heaviest and most general rains of the month, and the southerly gales in rear of it brought cold weather, with hail and snow in many places. There were also some thunderstorms.

RAINFALLS FOR AUGUST, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average August Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
North Island.						
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	6·43	15	1·95	5·12	40·89	38·76
Russell	7·70	13	2·78	4·70	71·81	37·30
Whangarei	7·94	17	2·38	6·31	49·44	45·10
Auckland	8·28	18	2·98	4·61	38·88	34·47
Hamilton	4·24	20	0·90	4·11	37·43	33·11
Rotorua	5·11	18	1·42	4·91	47·50	36·76
Kawhia	6·61	13	1·29	4·63	41·59	36·18
New Plymouth ..	6·87	23	1·63	5·49	41·45	40·41
Riversdale, Inglewood ..	12·22	25	2·00	8·89	67·63	67·60
Whangamomona ..	6·72	15	1·43	6·02	49·72	48·99
Hawera	4·93	18	0·96	4·50	31·87	30·11
Tairua	3·70	19	0·81	5·84	39·17	45·71
Tauranga	4·38	19	1·53	4·30	42·42	36·12
Maraehako Station, Opotiki	10·66	18	2·72	5·49	49·83	37·73
Gisborne	2·43	10	0·90	4·33	34·74	34·29
Taupo	4·64	22	0·87	4·07	36·06	29·30
Napier	1·19	12	0·44	2·95	38·83	22·30
Hastings	1·18	12	0·37	3·13	33·85	23·42
Whakarara Station ..	1·74	8	0·83	..	..	42·16
Taihape	1·70	22	0·44	2·74	31·70	23·52
Masterton	3·13	15	1·25	3·59	36·27	26·54
Patea	4·01	21	0·77	3·81	34·24	29·44
Wanganui	2·21	14	0·35	2·81	29·04	23·85
Foxton	5·07	19	1·02	2·95	29·31	21·33
Wellington	4·68	20	1·77	3·93	40·51	29·67
South Island.						
Westport	14·44	25	1·40	7·70	52·12	62·50
Greymouth	15·09	25	2·33	7·48	58·07	64·97
Hokitika	19·67	27	2·62	9·24	63·99	73·29
Ross	21·47	24	2·20	10·43	73·33	82·38
Arthur's Pass ..	17·95	21	2·75	10·20	78·27	96·07
Okuru, South Westland	21·82	20	2·10	11·24	94·13	93·80
Collingwood	16·29	22	3·13	7·11	65·19	62·09
Nelson	8·84	15	2·33	3·06	28·17	24·86
Spring Creek, Blenheim	4·71	14	2·37	2·75	26·03	20·64
Seddon	3·10	10	1·78	1·90	20·93	16·62
Hanmer Springs ..	2·04	10	0·58	3·42	39·30	29·48
Highfield, Waiau ..	1·31	7	0·47	2·45	28·29	22·53
Gore Bay	1·07	5	0·47	2·64	27·14	21·31
Christchurch	2·29	11	0·83	1·82	25·59	16·99
Timaru	0·87	7	0·56	1·45	21·97	14·43
Lambrook Station, Fairlie	1·23	10	0·39	1·53	19·24	16·13
Benmore Station, Clearburn	2·52	12	0·97	1·48	16·03	16·02
Oamaru	1·17	8	0·34	1·74	18·79	14·44
Queenstown	4·47	18	0·90	2·05	22·93	19·43
Clyde	1·23	10	0·29	0·79	9·27	9·45
Dunedin	3·52	10	1·09	3·07	31·45	24·13
Wendon	2·08	10	0·52	2·05	19·51	19·27
Balclutha	2·28	17	0·50	1·78	20·99	16·27
Invercargill	4·20	21	0·68	3·20	30·18	29·78
Puysegur Point ..	9·72	28	0·91	6·94	57·46	55·35
Half-moon Bay ..	6·64	21	0·84	4·39	32·74	37·92

LIVE-STOCK IN NEW ZEALAND, 1936.

UNLESS OTHERWISE SPECIFIED, ENUMERATED AT 31ST JANUARY.

Land District.	Horses as at 31st Jan., 1936.	Dairy Cows as at 31st Jan., 1936 (in Milk and Dry).	Total Cattle as at 31st Jan., 1936 (including Figures in previous Column).	Number of Sheep shorn, Season 1935–36.	Number of Lambs shorn, Season 1935–36.	Number of Lambs tailed, Season 1935–36.	Total Sheep (including Lambs) as at 30th April, 1936.*	Pigs as at 31st Jan., 1936.
North Auckland	30,329	381,465	680,896	973,669	193,482	528,895	1,069,488	151,223
Auckland ..	45,421	620,575	1,059,138	1,659,005	381,297	1,083,653	1,851,410	279,144
Gisborne ..	13,017	56,009	343,996	2,166,620	713,000	1,024,778	2,351,646	25,248
Hawke's Bay ..	16,670	75,614	341,628	3,528,322	639,878	2,043,007	4,074,414	27,779
Taranaki ..	17,436	264,487	435,775	891,036	238,420	530,764	915,841	91,970
Wellington ..	35,109	261,895	751,489	5,569,202	1,371,391	3,288,978	6,135,047	110,404
Nelson ..	5,507	35,082	71,021	382,816	14,293	175,381	439,542	18,283
Marlborough ..	5,765	16,292	40,769	1,029,128	19,236	475,180	1,133,510	7,494
Westland ..	2,143	16,427	46,670	68,116	6,766	55,224	77,817	7,213
Canterbury ..	51,258	82,137	176,858	4,531,177	30,759	2,976,738	5,544,583	50,972
Otago ..	29,720	60,984	138,129	3,342,333	5,535	1,904,007	3,875,123	22,011
Southland ..	23,795	80,540	167,709	2,137,053	4,591	1,610,012	2,570,712	16,722
Totals, 1936	276,170	1,951,507	4,254,078	26,278,477	3,618,648	15,696,617	30,039,133	808,463
Totals, 1935	272,986	1,952,094	4,293,499	25,639,654	3,529,202	15,689,492	29,076,754	762,755

* 1936 figures are interim only

—*Census and Statistics Office.*

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SOME ASPECTS OF POTASH MANURING OF PASTURES.

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POTASSIC fertilizers take a minor place among artificial manures in New Zealand as compared with most other countries, particularly those in Europe. For instance, in relation to the amount of phosphate used, the comparative figures for New Zealand and a few other countries are approximately as follows :—

Country.	Ratio of Phosphoric Acid (P_2O_5) to Potash (K_2O) used *	
	P_2O_5	K_2O.
New Zealand	30 to 50	1
Italy	7	1
Switzerland	3½	1
Great Britain	3	1
Sweden	2½	1
France	1½	1
Germany	½	1

* Adapted from tables in *The Fertilizer, Feeding Stuffs, and Farm Supplies Journal, N.Z. Jour. Agric.*, and Year-Book of International Inst. of Agric., Rome.

The wide difference is no doubt due to the systems of farming, since the countries contrasted with New Zealand are largely arable, and such potash-demanding crops as sugar-beet and potatoes form an appreciable part of the area under cultivation. Nevertheless, it is significant that the potash-producing countries Germany and France are the chief users of the material in its "artificial" form, although a perusal of literature and photographs, particularly from Germany, almost suggests that providence has mercifully placed deposits of potash where they are likely to be most needed.

TREND OF POTASH MANURING IN NEW ZEALAND.

The quantities of potash fertilizers imported into New Zealand fell considerably from 1929 to 1934. This is attributable largely to the lower purchasing-power caused by economic conditions and the increased cost of potassic fertilizers brought about by exchange and other import restrictions. In spite of this, some farmers have

steadfastly continued to use potash in addition to phosphates, but many who had hitherto incorporated it into their manuring practice preferred to reduce expenditure by cutting out the use of potash, and used only phosphatic fertilizers or phosphates with lime, and even reduced their applications of these materials. This reflects the attitude of the New Zealand farming community generally to manuring practice—*i.e.*, phosphate, by reason of its spectacular effect in converting poor pasture into good and its known ability to increase appreciably the stock-carrying capacity of most farms, is indispensable. Potassic and nitrogenous fertilizers, on the other hand, are viewed as mere accessories to increase production over and beyond the initial improvement effected by phosphates.

It is generally considered that far more phosphoric acid than potash is removed in the major products from New Zealand farms, but in the removal of meat, wool, wheat, butter, cheese, potatoes, and milk for human consumption* approximately 10,000 tons of potash (K_2O) are taken annually, as compared with 14,000 tons of phosphoric acid (P_2O_5), a ratio of 1 to 1·4. Milk for butter and cheese manufacture has been included in the estimate, but most of the fertilizing elements from milk for manufacture of these are returned to the farms, although not necessarily to the land, by way of separated milk and whey. The position, then, is of interest if viewed from the angle that in 1934 about 72,000 tons of phosphoric acid (P_2O_5) and about 2,000 tons of potash (K_2O) in artificial fertilizers went on to farms in New Zealand, while over 14,000 tons of P_2O_5 and more than 10,000 tons of K_2O were removed in the main products for human consumption. It is realized, of course, that such data cannot be taken as a criterion of the immediate fertilizer needs of our farm crops, but, on the other hand, it is obvious that this state of affairs cannot continue indefinitely, and that, sooner or later, potash manuring must take a more prominent place in fertilizer practice.

It has been stated frequently that New Zealand soils are generally well supplied with available potash, and it is quite obvious that on most soil types this element is in much greater supply than is available phosphate. In certain areas, however, assuming that soil analysis is a reliable guide, there are indications that no great surplus of potash exists, and it is on these that potassic fertilizers are likely to become necessary in the near future. The reliability of soil analysis in this connection will be discussed later.

THE NEED FOR POTASH MANURING ON PASTURES.

Under normal conditions grass takes up about four times as much potash as it does phosphate. Hudson(1) estimates that if all the herbage from a pasture producing 5,000 lb. of dry matter a year were removed it would be equivalent to the taking-off of 55 lb. lime (CaO), approximately equal to 98 lb. of carbonate of lime; 37 lb. phosphoric anhydride, approximately equal to 185 lb. of superphosphate; 150 lb. of potassic oxide, approximately equal to 500 lb. of 30-per-cent. potash salts; 150 lb. nitrogen, approximately equal to 750 lb. sulphate of ammonia. He further stated that

* Estimated from production figures for 1934 N.Z. Year-book, A. and P. Statistics, and based on tables in the "Agricultural Notebook" (McConnell) and "Feeds and Feeding" (Henry and Morrison).

under stock-grazing the amount returned to the pasture through the animal varies according to whether young stock, milking-stock, or mature dry stock are used. In the case of mature dry stock it is considered that most of the lime, phosphate, and potash, and a large proportion of nitrogen, is returned. The potash returned to the land through the stock is in a highly available form, and is easily utilized by the next generation of plants. Russell(2) states: "Dairy cows permanently remove more potash than bullocks, as also do growing sheep for their wool. This is shown by the fact that the quantities, in pounds, of potash (K_2O) removed annually per acre in a grazing season are bullocks, 250 lb. live-weight increase, 0·5; dairy cattle, 300 gallons milk, 5·0; sheep, 200 lb. live-weight increase, 30 lb. wool, 2·0. Heavy soils can supply all the potash needed, but light soils continuously used for sheep-grazing may ultimately fail to do so, and dressings of kainit may become necessary when the yields of mutton and of wool are being increased by basic slag. Where a hay crop is annually removed the supply of potash decreases, and unless more is added the yield falls to a lower level both in quantity and in value. The clovers especially suffer, having less power than some of their competitors to take potash from the soil, and, as they diminish, weeds come in to take their place." Thus, from the above, farms which may be first expected to show deficiencies of potash are those on light land, while fields which are most likely to respond to added potash are those which are repeatedly cut for hay.

TOP-DRESSING TRIALS WITH POTASH.

One of the major activities of the Fields Division of the Department of Agriculture is the carrying-out of simple observational trials on pasture to determine the main plant-food deficiencies in various districts, and since 1924 approximately 700 trials have been laid down throughout the Dominion. These trials are simple in design and rely wholly upon the visible differences apparent at the time of the Instructor's visit, which takes place about every two or three months. Included in the treatments are potash alone, phosphate (either super or slag) plus potash, and phosphate plus lime plus potash. Potash is applied annually in the form of 30 per cent. salts at the rate of 2 cwt. per acre, phosphate in its various forms at 2 cwt. or 3 cwt. per acre, and lime as carbonate at 1 ton per acre in the first year, with 5 cwt. per year subsequently.

Potash alone has given responses in only a very limited number of trials, and these have usually been apparent when the experiments were laid down on fields which were heavily phosphated previously. Occasionally, potash alone has proved detrimental to the general vigour of the sward, and in one trial in Poverty Bay the sward in the potash plot took on a most peculiar discoloured appearance, the grass assuming a brownish-purple colour and the clovers disappearing altogether. The addition of phosphate very largely counteracted this effect. In certain districts potash added to phosphate increases the production or improves the sward markedly as compared with phosphate alone. There is also a certain number of trials in which, although no appreciable effect is produced by the addition of potash to phosphate, marked results

are obtained by the combination of potash with phosphate and lime. Bell(3) comments on this freely in his review of potash responses in Auckland Province.

CHARACTERISTICS OF POTASH EFFECT.

In the subsequent remarks the effectiveness of potash refers to that brought about by 30 per cent. potash salts in addition to phosphate as compared with phosphate alone. The general effects of potash on the sward described by Bell are typical of those in most trials where this material has given visible results. Firstly, there is an increase in growth of all the clovers present. Secondly, the white clover eliminates the annual species and covers bare-ground spaces. Finally, the better grasses, if these were originally present, are improved as a result of the vigour of the white clover, forming a well-balanced sward of grass and white clover. This, in effect, is the same process of improvement wrought by phosphates in building up a sward after initial top-dressing. On a good sward the amount of growth is sometimes increased, and this is apparent when some of the trials are closed for hay. Almost invariably where there is a potash response a definite preference is shown to those particular plots by grazing animals. This palatability must not be confused with the partiality shown by stock to pasture immediately after it has been dressed with 30 per cent. potash salts or kainit, since the latter is largely due to the sodium chloride (present as impurity), which is particularly appetizing. The real ultimate palatability is probably associated with a higher potash content of the herbage as well as a greater clover content of the sward, and this takes place some time after application. Potash responses may be distinctly regional in their occurrence, sometimes they can be correlated with a definite soil type, in other cases climatic conditions play a large part, since heavier rainfall conditions appear to exert some influence

"POTASH-RESPONSE" DISTRICTS.

North Auckland.—Some good results from potash top-dressing have occurred on the peaty sands, on the red-brown soils derived from basalts, and on some of the mature podsols known as sandy gum lands. These types are scattered throughout the North Auckland Peninsula.

South Auckland.—Soil types similar to the North Auckland ones mentioned are found in the Manukau and Franklin Counties, and similar results have been obtained from potash except on the volcanic soils, where there is considerable variation in regard to response. In one or two experiments striking results have been obtained; in others, apparently on the same soil type, the results have been negligible.

Waikato.—As the soil types of the Waipa County have been accurately mapped by the soil survey, it has been possible to lay down a number of trials on given types. So far results favourable to potash have been secured on three trials on the Horotiu sandy loam, one trial on Kaipaki sandy peat, and one trial on the Hamilton clay loam.

Waihi.—Potash responses in this district have probably been more marked than in any other area surveyed, not only by the degree but also by the quickness with which they become apparent. Bell(3) considers

that these results are confined to the sandy loams and do not occur on the alluvial soils. The rainfall in this district is exceptionally high.

Taranaki.—A large series of experiments laid down throughout Western Taranaki have indicated that potassic fertilizers give favourable responses generally. The latter do not seem to be correlated with any particular classes of the three main volcanic showers as demarked by Grange and Taylor(4). Those trials located in North Taranaki appeared to show responses very quickly, more particularly in the high-rainfall belt close to Mount Egmont. In South Taranaki the results from potash have not been so consistent, nor have they been so quickly apparent as in the more northerly trials, but in a few cases quite striking results have occurred in the second and third years of the experiments. Two grazing trials in which potash-treated fields were compared with those receiving no potash, both receiving phosphate, were laid down in Taranaki in 1934. So far, two applications of 30 per cent. potash have been made. In the first season increases in grazing-days of 10 per cent. and 23 per cent. respectively could be attributed to potash, while in 1935–36 the increases were in the order of 62 per cent. and 17 per cent. respectively. The improvement in the sward on the two potash areas has been consistent throughout the period over which the trials have been conducted.

Southland.—Some of the experiments in Southland have already been summarized by Tennent and Stuart(5), who reported that the number of trials indicating responses from potash was high in Eastern Southland, while a few very good results had been obtained in Western Southland. In the former district potash was most consistently effective in the Mataura Valley, where excellent results from its use as a top-dressing material have been recorded.

Raetihi.—Fairly definite results were secured in a few trials in the Raetihi district, the soil of which, according to Grange(6), is formed from a volcanic shower of andesite.

Other Districts.—Isolated instances where potash was effective occur in other districts, but either they are not substantiated by like results or sufficient trials have not been laid down to definitely refer to these areas in the same manner as the foregoing.

In the following districts only a small proportion of trials has given visible results from potash, and, when apparent, they have been slight or spasmodic: Bay of Plenty, Poverty Bay, Hawke's Bay, Manawatu, Marlborough, Westland, Canterbury, and Otago. Results of trials in many of these districts have been published(5), (7), (8), (9), and (10).

It must be emphasized that since potash alone applied to a grassland sward has generally failed to show appreciable results, the effects quoted above are those from potash plus phosphate as compared with phosphate alone, or those from potash plus phosphate plus lime as compared with phosphate plus lime. Therefore, if phosphate, with or without lime, gives marked results over no treatment, any extra impetus given to growth by the addition of potash may be difficult to see. On the other hand, if phosphate, with or without lime, produces little change over no treatment, there is more chance of any extra improvement caused by potash being observed. In the latter case, however, it is considered that potash may be a major limiting factor, and it is the major

limiting factors which these observational trials are designed to detect. The actual amount of improvement brought about by any of the treatments can only be measured by trials of a more refined nature, and it is hoped, ultimately, that these will follow when the main regions of fertilizer responses have been mapped out.

In regard to the different potassic fertilizers available, 30 per cent. potash salt has given slightly better results than its equivalent in sulphate of potash or muriate of potash. Trials with varying quantities of the former have indicated an appreciable superiority of 2 cwt. per acre over 1 cwt., but applications of 3 cwt. per acre did not appear to be substantially better than 2 cwt. dressings.

QUALITY OF PRODUCE.

References to potash manuring promoting quality in the products of grassland are somewhat vague. In an experiment at Marton(11) Hudson and Doak reported that, while potash added to phosphatic and nitrogenous fertilizers had produced only a slight dry-weight increase, the potash content of the herbage from such plots was at all times higher than that from plots not receiving potash. These writers quote Woodman and Underwood(12), who state "there is no important reason for attempting to improve the potash content of the herbage by manurial treatment, since *untreated* herbage contains sufficient to supply the requirements of grazing animals" The function of potash in animal nutrition seems to be obscure, and, in regard to nutrition, it does not appear of very great moment whether the dry matter contains 2 per cent. or 3 per cent. of potash (K_2O).

In supplying potassic fertilizers the farmer is chiefly concerned with yield-increase, firstly of grass and secondly of the live-stock product, and there is quite a difference of opinion relative to the factors correlating yield of grass and yield of animal product.

POTASH IN THE SOIL.

Estimations of available potash in the first 3 in. of soil do not suggest any correlation between the figures so obtained and the potash responses. In point of fact, Bell(3) quotes analyses showing a Waihi soil, which was particularly responsive, as having an available K_2O content of 0·098 in the first 3 in. Numerous soil-samples from Taranaki could also be quoted to support the unreliability of soil analyses as a guide to manuring practice. There is a school of thought which supports "massive" applications of potash, or, in the words of Eckstein(13), "If a fertilizer experiment be laid down on a soil which tends to absorb potassium energetically, applications of potash may at first show no effect, not because the soil is rich in potash but because the degree of saturation of the soil colloids with respect to potassium is too low." Trials which have been laid down some years, but which in the earlier stages showed no appreciable responses to potash, commenced to give results last season. It will be interesting to see whether this is maintained in another year, in view of Eckstein's hypothesis, but, on the other hand, last season was a particularly wet one, and the high rainfall may have been a factor contributing to a spasmodic improvement.

Summary of Present Knowledge.

(1) The use of potash alone for top-dressing pastures has proved in the main to be ineffective. In isolated cases good results have been obtained, but, conversely, in a few specific instances detrimental effects have been recorded.

(2) Certain districts enumerated appear to be definitely responsive to top-dressing with potash in conjunction with phosphates, or phosphates and lime, and good results have been recorded in these localities. Such responses have been characterized by an increased content and vigour of clover in the sward. Thus white clover can be regarded as the index plant for soil-requirements of phosphates, lime, and potash.

(3) Evidence tends to show that the improvement of white-clover growth may be the main contributing factor in the increased palatability of the herbage which is often associated with such responses.

(4) Some of the best results have been obtained on pastures which had previously been cut for hay or silage frequently.

(5) Areas on which potash has been effective have several features in common: (*a*) They are generally subject to high rainfall; (*b*) the soils are mostly light in texture or have been well leached; (*c*) in general the soils derived from andesite and basalt show more consistent responses than do those derived from rhyolite.

In conclusion, it should be pointed out that most of the trials carried out so far have been qualitative only, and that it is hoped to carry out more comprehensive experiments on areas showing the major potash responses. Nevertheless, the observational trials carried out have indicated that in certain districts potash can definitely be recommended. The data from the more detailed experiments, together with the general survey of fertilizer responses and the soil survey which is at present being carried out by officers of the Geological Survey, probably will add greatly to our knowledge of fertilizer deficiencies and their alleviation.

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DEFICIENCIES KNOWN AND SUSPECTED IN LIVE-STOCK NUTRITION OF NEW ZEALAND.

THE PRESENT POSITION AND FUTURE WORK.

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NUMEROUS instances have been recorded in New Zealand in which domestic animals have failed to grow or to produce to their full capacity through the entire lack of or the reduction to a low level of some of the essential food factors required by the body. Deficiencies of iodine and phosphorus undoubtedly exist as such, while cobalt and iron deficiencies are as yet interrelated. Calcium and magnesium deficiencies may or may not exist, while protein deficiency is also to be considered only as a possibility. Vitamin deficiencies, particularly A and D, may exist in intensively fed stock such as pigs and poultry, but except in pigs are to-day relatively unimportant in New Zealand live-stock feeding.

IODINE.

A considerable amount of analysis of New Zealand food, water, and soils has been performed by Hercus and his co-workers. More recently Mason and Sykes, working in the Chemical Laboratory of the Department of Agriculture, have carried out extensive analyses of thyroid glands of lambs in an attempt to survey the iodine content of districts. Shore and Andrews have also added considerably to the knowledge of the position in certain parts of New Zealand. The survey is now well forward, and is being continued by the Department of Agriculture, with the result that the deficient areas of New Zealand are fairly well mapped out.

Iodine deficiency generally in New Zealand is not considered sufficiently widespread to cause hairlessness and mortality in young pigs, nor to interfere to any extent with the assimilation of calcium and phosphorus nor the production of milk. There are, however, to be seen cases of goitre in calves and lambs in districts known to be low in iodine and where salt-licks have not been provided. Such an example was reported at Wanaka by Dayus and others. Incipient goitre may also be noted in calves in deficient areas, as reported by Webster in North Taranaki. Provided that an iodized-salt lick is used in known deficient areas, there is no necessity to add potassium iodide to licks in a general way as fashion prompted some years ago.

So much critical work has been performed on endemic goitre as opposed to exophthalmic goitre that it is now practically an accepted fact that endemic goitre results from a deficiency of iodine in the food intake, or because of poor assimilation of the iodine present. That being so, all that remains for workers in New Zealand to do is to map clearly areas of shortage quantitatively so that the necessary iodized-salt licks or foods rich in iodine may be given to domestic animals in those areas. Such work belongs to the chemist and soil-survey officers, but correlation of this work with animal disease should also be considered.

PHOSPHORUS.

Phosphorus is the limiting factor in development of the skeleton, milk-production, and œstrum. There is usually a greater deficiency of phosphorus in the food intake than there is of calcium, but it is necessary to have some optimum balance between calcium and phosphorus to get the best results in production and reproduction.

There is considerable variation in calcium and phosphorus in New Zealand pastures. Where intensive dairying is carried out the pasture analysis shows that the richest pastures contain 1 part each of calcium and phosphorus in 100 parts of dried material. Where œstrum is failing, phosphorus has probably dropped to 0·2 per cent., while rickets and osteoporosis occur at slightly higher levels in growing animals. An excess of calcium can so bind phosphorus that the animal remains deficient even though the quantity of phosphorus with a lowered calcium would be sufficient for ordinary purposes of animal metabolism.

Bone-softening (osteomalacia) may be due to deficiency of vitamin D preventing assimilation of calcium and phosphorus as in pigs and dogs, to excess of phosphorus over calcium as in lambs on green oats, and in horses, or to deficiency of phosphorus alone, largely seen in herbivora. This latter is the more common. Phosphorus deficiency is New Zealand has always been common, and acute phosphorus deficiency was given the name "Waihi disease" in earlier days. Fragility of bone and lack of sufficient phosphorus in the soil and pasture led to medicinal treatment with iron phosphates and to soil top-dressing with bonedust, and later with superphosphate. Because of the habit of stock of chewing bones when phosphorus deficiency developed, green bone was given to cattle, and later steamed bone flour was given in salt as a lick. As bone flour contained calcium as well as phosphorus, the provision of a bone-flour lick was a rational form of treatment, and, where the soil itself could not be treated by top-dressing, still is a very useful method of giving phosphorus to stock. By its use many areas of New Zealand have increased their calf and lamb crop from 40 per cent. to 90 per cent. and over, and have very greatly increased the milk-yield of both ewes and cows.

The rational use of superphosphate as a means of increasing production is to be commended, but the use of enormous quantities of superphosphate alone on land already low in calcium is to be deplored, for it may easily defeat its own object and bring about deficiency of calcium in the body and cause stock ailment.

It can be assumed that almost any part of New Zealand not using some form of phosphatic top-dressing is deficient in phosphorus. That being so, it is advisable that stock-licks composed of bone flour and salt should at all times be provided for stock, and more particularly for dairy cows, the phosphorus excretion of which is so extraordinarily heavy.

Research work on phosphorus assimilation in stock is by no means finished, but the more important aspect is the finding of the correct balance between phosphorus and such other minerals as magnesium and calcium, and other food constituents such as protein. This latter aspect is one in which drought areas are more interested. Blood chemistry has become helpful in diagnosis, but still is full of pitfalls, while bone analysis of animals can be used to some extent to map out deficient areas.

Calcium.

As has been discussed already, calcium is largely bound up with phosphorus in animal metabolism, and it is advisable to maintain a reasonable balance between the two minerals. Rickets is frequently considered to be due to calcium deficiency, but Sir Arnold Theiler taught that the limiting factor can always be found to be phosphorus in bone troubles of stock. It would, however, be reasonable to assume that with low calcium and high phosphate, as in green oats, upon which growing lambs become bandy, the low calcium is as limiting a factor if not more so than the phosphorus. In such feeding the calcium is still further bound by the high phosphorus.

Although very little real proof exists, milk fever and bloat in dairy cows and sheep are believed by some workers to be due in part to the lack of balance of calcium and phosphorus. The hypocalcæmia which is present during the coma of milk fever is cured by addition of calcium to the blood-stream, and appears to be prevented by the addition of burnt lime to drinking-water or to soil prior to calving. It has also been noticed that an increase of lime to pastures has prevented bloat, but it is not possible to show by analysis of blood or bones of animals that there has been an actual shortage of calcium. The shortage may have been sufficient in the case of bloat, however, over a long period to produce a lack of tone in the alimentary system

Much work could be performed in certain districts on the effect of lime in prevention of bloat and milk fever, taking into consideration the possible change in pasture-plants brought about by top-dressing and the chemical change in organs of the animals. The effect of deficiencies of calcium and magnesium on parathyroid of cattle and sheep and the detrimental effect of increases of phosphorus could very profitably be examined.

Magnesium.

In some of the particularly rich dairying districts of the North Island a condition in cows known as "grass staggers" occurs shortly after calving in the early spring. Investigation has shown that the blood is temporarily deficient in magnesium yet the total quantity of magnesium in the body has not been lowered. Analysis of pasture has shown no deficiency of magnesium, but there is usually a high phosphorus content and a tendency for a low calcium content. "Grass staggers," *post partum* paralysis, and milk fever seem to occur on the same farms, and it would appear that there is a lack of balance of phosphorus as against magnesium and calcium.

Trials of feeding of dolomite and magnesium sulphate in silage, licks, or drinking-water have been carried out fairly extensively, and one believes that by such methods of increasing the bodily content of magnesium that the animals can resist "grass staggers." It has been noted that there is a definite temporary drop of magnesium in the blood of animals placed on rich pasture after a winter feeding of hay and non-growing poor grass. Future work must be carried out to find the reason for this temporary drop of blood-magnesium, and such work would appear to be bound up with the practice of superphosphate top-dressing, or else with the use of selected strains of grasses.

IRON AND COBALT.

For many years Aston's theory of a definite iron deficiency being causative of anæmia in ruminants in certain areas of the North Island was rigidly adhered to and accepted as a reason for anæmia and death not only in New Zealand, but in other well-known areas of the world. Aston's finding and utilization of limonite as a commercial source of crude iron for preventing bush sickness was epoch-making. The fact that burnt limonite and limonite from other sources than the original were inert gave the clue to the possibility of other metals present in limonite in trace quantities being necessary for iron assimilation or for themselves alone. Already at this stage it was known in Florida that copper was required in conjunction with iron. Filmer and Underwood in Australia, finding that some other substance was contained in limonite, and that probably cobalt or nickel was the active material, led to work in South Australia by Marston and in New Zealand by Rigg and others at Cawthron, with the result that cobalt can now be used as a preventive in salt licks at the rate of 2 oz. to the ton of salt in certain South Island areas previously considered bush sick or nearly so. Similar work is about to be carried out in the North Island. Trace elements such as cobalt are found remarkably deficient in some areas of New Zealand, and cobalt is almost absent in many of the volcanic showers and in places such as Morton Mains. It would seem unnecessary to give iron as such in these known deficient areas, and to give in its stead a cobalt salt. Therefore, if that be so, one is not correct in speaking now of an iron deficiency.

The interaction of cobalt and iron in prophylaxis is not properly known, and whether cobalt acts as a direct blood-cell stimulant only or has some catalytic action on iron as well remains to be seen. Cobalt in excess will increase the number of reticulocytes and the hæmoglobin in blood, a fact which has recently been demonstrated in rats at Wallaceville. The work on this problem must be experimental on farms in affected areas, but it must be well controlled. Blood histology and chemistry is necessary to put the pathology of the disease on a proper footing. A continuation of soil survey, soil and pasture chemistry, and analysis of animal organs from experimental animals is also part of the research programme. Also production of anæmia in experimental feeding of cobalt-free diets would be of very great use. How a definite deficiency of cobalt or other minerals can exist without affecting animals such as horses, pigs, and rabbits is a matter for investigation.

VITAMINS.

Vitamin deficiencies can exist only under conditions of poor husbandry, and are not dependent on deficiencies in soil and pasture to any extent, with the possible exception of vitamin A in drought seasons and in swine husbandry. They do not, therefore, come within the scope of this paper.

PROTEIN.

Total-protein deficiency can exist on poor pastures, again mainly under drought conditions. Such a deficiency causes sarcophagia in animals, but with such favourable climatic conditions as exist in New Zealand one would scarcely expect to see evidence of lack of total

protein. There may, however, be a deficiency of certain amino-acids—that is, the food of stock may not be rich enough in complete proteins. This is considered to be a possibility in male infertility. It is known that high protein can cause male infertility in rat experimental work, and also that incomplete protein can also set up a similar testicular atrophy. The work on rats is at present being carried out on diets known to be incomplete in protein but complete in all other forms of food. Additional amino-acids are being fed with this basal diet. Considerable chemical assistance is required to list the amino-acid content of the pastures, animal organs, and experimental foods before this rat work will be completed. In turn the rat work has still to be repeated on domestic animals and so become translated into field practice.

USE OF PASTURES AND PASTURE-EQUIVALENTS IN PIG-KEEPING.

RECOMMENDATIONS OF THE MANAWATU-OROUA PIG RECORDING AND DEVELOPMENT CLUB.

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THERE are great variations in the degree of success with which pastures are being utilized in pig-keeping. These variations are due primarily to differences in the extent to which pasture utilization by pigs is based upon the following important facts.

The digestive organs and processes of pigs differ materially from those of other farm animals fed on pastures—e.g., *sheep and cattle.* From the digestive viewpoint cattle and sheep are much better fitted naturally to utilize much more bulky foods of low digestibility than are pigs. In the first place, cattle and sheep, but not pigs, are ruminating animals. In ruminating animals the food after being swallowed for the first time does not ordinarily reach the true digestive stomach until it has been first brought back to the mouth, where it undergoes a very thorough mastication or "chewing of the cud" which reduces it to a finely divided condition that facilitates the action of digestive juices. This in its turn enables the ruminants to digest more effectively than non-ruminants feeds of low digestibility, such as woody or stemmy crops—*e.g.*, pastures of rank or mature growth. In the second place, the alimentary canal in which digestion takes place is relatively much greater in cattle and sheep than it is in pigs.

The volumes of the alimentary canal in different animals computed from data given by Colin are—

	Volume of Alimentary Canal per 100 lb. of Live-weight. (In Pints.)
Cattle	50 to 60
Sheep	50 to 60
Pig	16 to 20

These figures, which obviously vary, depending on the size and condition of the animal, are in general agreement with those of other authorities.

The volume of the alimentary canal is of basic importance in feeding. Its function has been likened rather aptly to that of factory-space. Just as a large factory can handle more material than a small factory, so, in a similar way, an animal with an alimentary canal of large volume in comparison with its weight can utilize bulky supplies of feed better than can an animal having an alimentary canal of comparatively small volume. In this case feed is the raw material out of which flesh or milk is manufactured, and from the previous data it is clear that the cow and the sheep have spacious alimentary canals in comparison with the pig.

There are great differences, vital in pig-feeding, between the characteristics and feeding-values of pastures of leafy relatively short young growth and of ones of stemmy mature or rank growth. These differences are intensified when the latter pastures are characterized by the absence, or the markedly scant supply, of clovers, which are specially rich in proteins and mineral matter.

The comparative feeding-values of leafy growth of pastures and of stemmy growth may be gauged from the following facts: (1) The dry matter of samples of leafy pasture contains approximately twice as much phosphate and lime as the dry matter from corresponding herbage at the hay stage. (2) The dry matter of leafy pasturage contains approximately two and a half times as much protein as occurs at the hay stage. (3) About 80 per cent. of the dry matter of leafy pasturage is digestible, whereas only from 40 per cent. to 60 per cent. of the dry matter of stemmy growth is digestible.

The true significance of these three facts lies in the further fact that the rations of animals capable of a high rate of production, such as pigs, are apt to fall short of the full requirements in respect to their mineral and protein contents and their digestibility.

From this it follows that any system of pasture utilization which brings about rank herbage or which lessens the clover content of pastures is in those respects unsuitable in pig husbandry.

There are important differences between (a) *leafy growth of pastures, roots, and green crops and* (b) *skim-milk, whey, cereal grains and meals, and meal and fish meals.*

The position is indicated by the following table :—

Yield of Nutritive Material (expressed as Pounds of Starch Equivalent) from 100 lb. of Dry Matter.

	Lb.
Skim-milk	99
Whey	93
Maize	96
Peas	90
Barley	87
Meat-meal (containing a good deal of fat)	137
Leafy grass	70 to 80
Carrots	70
Swedes	66
Chou moellier	66
Coarse grass	40 to 50
Hay	30 to 45
Straws	15 to 25

This table shows that feeds can be grouped into three distinct classes—(i) Poorly digestible or bulky; (ii) readily digestible or non-bulky. Cereals, meals, and skim-milk belong chiefly to the latter, in which skim-milk is outstanding; while hay, straw, and coarse grass belong to the former. To obtain any given amount of nutriment the digestive apparatus of the animal has to deal with much more feed material (irrespective of its water content) in the case of the former than that of the latter, which therefore are more suited in general to the needs of animals with relatively small volume of alimentary canal. (iii) Leafy pasture-growth, root crops, and green fodders before they become woody are intermediate in character: in practice they serve as readily digestible non-bulky feeds when not fed in excess, or as poorly digestible bulky feeds when fed in large amounts.

Because of the limited capacity of the alimentary canal of the pig the difference between bulky and non-bulky feeds is of prime importance. Hence it is well to bear in mind that a feed which from the storage viewpoint is bulky is not necessarily bulky also from the nutritive viewpoint Bulkiness in respect to nutrition is governed largely by the character of the dry matter: if a substantial amount of the dry matter is not readily digestible, as when the feed is woody or of high fibre content, then for nutritive purposes the feed is bulky, whereas if the dry matter is of high digestibility, as when its fibre content is low, then the feed is non-bulky. Hence, for practical purposes skim-milk, from which fibre is absent, is non-bulky, whereas hay or silage, with a fibre content of 25 per cent. to 35 per cent. of its dry matter, is bulky, and pasture-growth with a fibre content of 10 per cent to 20 per cent. of its dry matter is of intermediate type The bulkiness of the feed itself as distinct from its dry matter is of some moment, but the dominant consideration is the character of the dry matter as determined largely by its fibre content.

There is a close and inescapable connection between economy in feed-consumption and rapidity of growth This may be illustrated by considering the feed requirements of a pig of 200 lb. live-weight. Such a pig requires for mere maintenance the equivalent of 3·6 lb. of meal daily and an additional 2 lb of meal or its equivalent for each 1 lb. increase in live-weight. Hence, if such a pig is growing at the rate of 1 lb. daily a total of 5·6 lb. of meal or its equivalent is required to produce 1 lb. increase in live-weight, but if the pig is growing at the rate of only ½ lb. daily then 9·2 lb. of meal is required to obtain 1 lb. increase in live-weight. This means that in respect to production of flesh the effectiveness of the feed used at the slower rate of growth is only 60 per cent. of that of the feed consumed at the quicker rate of growth. Keeping this in mind, let us return to the use of bulky and non-bulky feeds. In growing animals the maintenance requirement is met first, only the balance over and above this requirement being available for production. If the pig, with its limited "factory" capacity, is fed on bulky feeds the nutriment available will be only little, if at all, in excess of the maintenance requirement: if the pig is given non-bulky feeds comparatively large amounts of nutriment will be available for

production. Hence, if it is desired to obtain growth at the maximum rate then easily digestible non-bulky feeds should be fed. Such easily digestible non-bulky feeds are often called "concentrates," the most important of which in New Zealand dairying are skim-milk (a diluted concentrate), cereals, and peas.

It follows from the facts just considered that in the interests of feed-economy concentrates such as skim-milk should be used as exclusively as possible in the production of flesh, and to enable this to be done less concentrated feeds, such as pasture-growth, root crops, and green forage crops, should be used mainly—and as much as possible to replace concentrates—for maintenance. The more such crops can be used for maintenance the greater is the amount of farm-produced concentrates available for flesh-production with a minimum of feed-consumption. This is the key to the judicious use of pastures and pasture-equivalents in pig-keeping as a subsidiary venture to dairying. In dairying the production of concentrates in the form of dairy by-products is distinctly and definitely limited; the provision of other concentrates, such as the grains of barley, maize, and peas, either by farm-production or by purchase, is costly in comparison with the provision of less concentrated feeds such as pasture-growth, root crops, and green crops.

Access to pastures or crops of similar nature is frequently valuable because of the exercise it provides and because of its influence upon the health of animals. This results from the freer provision of vitamins and of sunshine.

The pig, whether it be the sow with young or the growing animal, normally is capable of high and efficient production One aspect of this is reflected in the computation that for 100 lb. of digestible nutrients consumed (*a*) The pig produces 25 lb of dressed carcass, equivalent to 15 lb. of edible dry meat, (*b*) the sheep and steer yield less than 10 lb. of dressed carcass, equivalent to only from $2\frac{1}{2}$ lb. to $3\frac{1}{4}$ lb. of edible dry meat.

But from data already discussed it is clear that such economical conversion of feed into meat is compatible only with feeding which allows the maximum rate of growth to be attained. This in its turn is incompatible with the free use of somewhat coarse feeds of relatively poor digestibility or the general toleration of any substantial "store" period in the case of animals being prepared for slaughter. The sow with young ranks with the rapidly growing pig in its high rate of production and in its need for a high standard of feeding. The position in respect to well-developed dry breeding-animals is somewhat different, rations slightly in excess of maintenance requirements normally being sufficient for these. Further, a "store" period in the case of animals being grown for slaughter is at times justified, when, for instance, the "store" period enables advantage to be taken later of a cheap concentrate as occurs when pigs are wintered as stores and finished off on dairy by-products in the spring, and when the alternative to the store period would be the use of concentrates, expensive in comparison with dairy by-products. In such cases the winter "store" period—*i.e.*, the period of relatively slow growth—involves the use mainly of farm-grown crops, which can be provided at a comparatively low cost.

SUMMARY OF BASIC PRINCIPLES OF SUCCESSFUL UTILIZATION OF PASTURES BY PIGS.

To sum up, the successful utilization of pastures and kindred crops in the production of pig-meat as a subsidiary to dairying are based largely upon the following considerations :—

(1) The digestive organs of the pig are unfitted to utilize coarse bulky feeds effectively.

(2) Coarse swards containing but scant amounts of clovers are substantially inferior to the short leafy growth of well-balanced mixtures of grass and clover in respect to their digestibility and their content of flesh-forming substances and of mineral matter.

(3) To exploit the capacity of the pig for high production and rapid growth, highly digestible rations rich in minerals and flesh-forming substances must be provided as far as is compatible with costs and returns.

(4) Economy in feed-consumption is governed by rapidity of growth.

(5) While highly concentrated feeds such as skim-milk and cereals are desirable for rapid growth, less concentrated feeds serve well for maintenance.

(6) The less concentrated feeds as a rule are cheaper or more easily obtainable than the highly concentrated ones. the use of which should be confined as much as practicable to the pigs of highest production—*e.g.*, pigs for slaughter and sows with young

(7) Irrespective of direct feed-economy, access to pastures and other crops of similar nutritive value is useful in respect to health and to exercise, which may affect carcass quality.

PRACTICAL APPLICATION OF THE PRINCIPLES

The application of these concepts in practice may be summarized as follows :—

(1) Pasture-utilization should be based upon *extensive* rather than upon *intensive* methods of grazing.

(2) Considerable use should be made of pastures for—

(*a*) Dry sows :

(*b*) Suckling sows with litters :

(*c*) Not as a rule for pigs definitely being fattened, for which, however, access to pastures at regular intervals should be provided. Especially, however, should young pigs have access to pastures and outdoor conditions for some time immediately after weaning :

(*d*) Store pigs only if fluctuations in the feed-supply make this advisable ; generally a store stage is undesirable.

(3) It is desirable to provide pasture-equivalents for use during periods of pasture-shortage ; crops which yield suitable equivalents, including lucerne, subterranean clover, broad red clover, Montgomery red clover, green cereals, and chou moellier and roots.

(4) Where practicable it is desirable to grow cereal crops or peas for grain, such crops because of their less bulk being valuable in conjunction with the pasture-equivalents.

EXTENSIVE VERSUS INTENSIVE METHODS OF GRAZING.

Extensive methods of grazing may be practised by giving the pigs range over pastures of several acres the feed from which is consumed mainly by dairy cows. It contrasts with the intensive method of grazing, in which the pigs are confined to relatively small areas of grassland: one of the layouts which has been recommended commonly for this purpose provides for the subdivision of an area of 2 acres into ten small paddocks to which access is given by a central race and beyond which the pigs are not to be allowed to graze. It has been demonstrated that the intensive system, involving the use of only small paddocks, when operated with suitable equipment facilitates the convenient and systematic feeding of pigs; further, because of its open-air character and the grazing that it permits, it is definitely superior to a system under which pigs have little or no access to grassland. On the other hand, it has been found in practice to have certain substantial disadvantages apart from its cost, which is considerable.

In the first place over a wide range of conditions, in winter and early spring, when usually leafy feed is particularly needed, the small paddocks are "poached" or "pugged" or productive of comparatively little feed. In the second place, eventually, and indeed fairly soon, the feed in the small paddocks deteriorates greatly, becoming less wholesome and less attractive. This is due to unavoidable changes in the composition of the swards of the small paddocks, changes which necessarily arise from the enrichment of the soil due to the excreta of the pigs. The changes normally consist of clovers being suppressed and grasses becoming dominant and coarse. It becomes difficult, if not impracticable, to keep the resultant herbage short and leafy, and even if it is kept fairly short and leafy it may be expected to be relatively poor in mineral matter, which is believed to be of considerable moment in the nutrition of pigs. It would be much better to avoid, as far as possible, the undesirable change in the composition of pastures by having the animal manure from the pigs distributed as evenly as possible over, say, 12 acres to 20 acres instead of 2 acres—a result which is at least partially secured under extensive methods of grazing. Distributed over the larger area the manure leads to improvement, whereas concentrated on the smaller area it leads to deterioration of pasture.

Grazing by the extensive method is sometimes far from successful. To be successful the grazing must be arranged in such a way that the pigs receive not only highly nutritious feed—fresh, leafy, and satisfactorily rich in clover—but also ample amounts of such feed. In the winter especially pigs are often grazing on bare pastures. Poor results may be expected from pigs so grazing unless suitable supplementary feeding is carried out, just as the results are poor from cows grazing on bare pastures without suitable supplementary feeding.

Because of the highly profitable returns obtainable from well-fed pigs, and because good feeding of the pig calls for the provision of feeds of relatively high nutritive value and digestibility, there is no justification for management which gives the pig second

place to the dairy cow as is sometimes done by making pigs "followers" to cows on pastures. When this practice is adopted the cows naturally consume the choice leafy herbage, leaving the comparatively inferior stemmy herbage for the pigs, which are less fitted physiologically to use such herbage effectively than are dairy cows.

Against grazing by pigs on wide range by the extensive method it has been objected that damage to the pastures results from the rooting habit of pigs. It has been shown that danger of such damage can be removed by suitable "ringing" of the pigs. Another objection often raised to extensive grazing by pigs is that ordinary fencing is insufficient to keep pigs from roaming widely and even on to neighbouring farms. Experience shows that as a rule pigs do not pass through a seven-wire fence reasonably well made and maintained, but that fences in bad repair and poor feeding both beget wandering habits, which are not eradicated readily and which may lead to pigs going through even good fences. Further, areas of special crops usually can be secured without much effort or cost. A further objection raised to extensive grazing is that the pigs would be subject to tubercular infection from herbage contaminated by infected cows. Veterinary opinion is that generally any danger in this connection is small, that it is at least offset by the greater vitality with greater general resistance to disease which results from the more healthy conditions provided by extensive grazing, and hence that the expectation of disease in pigs on wide range is less than in confined pigs. A possible exception to this arises in the case of pigs grazing after cows suffering from tuberculosis of a type which leads to discharge of the tubercle on the herbage.

While as much extensive grazing as possible is advocated, it is not to be deduced from this that no small paddocks are desirable. As is indicated later, the use of small paddocks for particular purposes and particular circumstances is recommended. But because of the cost of providing small paddocks suitably equipped for the convenient watering and feeding of stock, and also because of the drawbacks to the small paddocks relative to grazing which have already been considered, the aim throughout should be to reduce the number of small paddocks as much as is possible having regard mainly to the beneficial influence a small amount of green feed, exercise, and open-air life may have upon the well-being of the pig.

Dry Sows on Pastures.

Great success has attended the grazing of sows between the weaning of one litter almost up to the farrowing of the following litter. When the pastures used for this purpose have been ones of high quality yielding leafy herbage sows have lived largely, if not wholly, on the pastures alone for long periods, and the subsequent results have been good. The mature sow can with safety live more completely upon pasture-growth than can the young developing sow, the requirements of which are greater to meet not only the needs of maintenance and pregnancy which are common to both mature and developing sows, but also those of growth. The feeding of sows on pastures in this manner is of great practical moment

because it increases the proportion of dairy by-products available as a concentrate or non-bulky feed for use in rapid flesh-production by pigs for slaughter. That quite a substantial amount of additional cheap concentrate may thereby be made available for rapid flesh-production may be gauged from the fact that the maintenance requirement of two pigs of 250 lb. live-weight has been estimated to be approximately equal to the maintenance requirement of a cow of 800 lb. live-weight.

Probably the feeding of breeding-sows extensively upon pastures of poor or badly balanced botanical composition or of stemmy over-mature growth would provide a deficient diet and result in poor litters. On the other hand, observation shows that, if no other factors intervene, good litters may be expected from sows grazing on pastures providing abundance of high-quality leafy herbage.

Sows with Litters on Pastures.

The essential difference between the grazing management of dry sows and that of sows with litters arises from the desirability of having full control of the litter. One way of securing this is the provision of a small paddock of grass to which there is access from the stationary farrowing-quarters. This small paddock probably is of more value as an open-air accommodation area than as a grazing-area from which nutriment is obtained. What is a suitable size for such a paddock varies with the nature of the soil—a smaller paddock suffices on well-drained soil. Paddocks ranging in size from about $\frac{1}{8}$ acre to $\frac{1}{5}$ acre are proving serviceable according to the conditions.

Such small " accommodation " paddocks should have direct access to larger paddocks for grazing by the extensive method when the litter is old enough to be allowed wide range—*i.e.*, after it is about four weeks old. Up to weaning, the sow with litter is fed and housed at the farrowing-house.

Store Pigs on Pastures.

The normal procedure, having due regard to feed-supplies and feed-costs, should be to eliminate a store stage by providing from weaning to slaughter stage rations which meet not only maintenance requirements, but also full production requirements. Such rations provide the essential basis for the rapid growth and consequent economy of feed which has already been discussed. However, as the result of seasonal fluctuations in the supply of cheap concentrates—*e.g.*, dairy by-products—it may become possible to supply such rations only in the form of farm-grown or purchased concentrates, and this at a cost which is not economic or maybe not so economically attractive as would be an alternative course. This alternative course consists in having the growing pigs pass through a store stage, during which they are fed largely on pastures or pasture-equivalents which provide a relatively cheap supply of feed. The wintering of store pigs which later utilize effectively the supplies of dairy by-products in the spring often is a useful application ot this. For this purpose, when the supply of feed directly available

from pastures is inadequate, it often may be supplemented suitably by the use of one or more of several farm-grown crops, including mangels, carrots, swedes, pumpkins, chou moellier, temporary pastures, green cereals, and subterranean clover; and the use of limited amounts of concentrates—*e.g.*, grains of cereals, including maize, peas, meat-meal, and meals of similar nature—to supplement such crops is usually sound economically. Similarly, in the latter part of the summer, if the milk-production falls off at an abnormally rapid rate because of exceptionally dry conditions a store stage for growing pigs may become advisable, and then areas of lucerne and pastures rich in red clover are fitted to provide valuable yet cheap grazing. The best results from the grazing of store pigs are normally obtained from adoption of the extensive method of grazing, and the pigs may be accommodated in special inexpensive housing.

THE USE OF GRASS FOR PIGS BEING FATTENED.

Recent investigations carried out at Massey Agricultural College and at Ruakura Farm of Instruction give results which are in agreement and which also are in general agreement with the results of similar overseas investigations. Further, these results confirm the experience of many successful farmers in indicating that little, if anything, is to be gained in regard to direct economy of feed from the grazing of pigs being prepared for slaughter. Hence the use of fattening-pens is advocated. It is considered advisable by some, however, that, in general, pigs being prepared for slaughter should not be confined continuously throughout the after-weaning period to the fattening-pens. Because of this each fattening-pen should have a companion small paddock of grass to which the pigs should be given access for relatively short periods at regular intervals. Farmers who adopt this practice consider that it fosters good health, and that in the case of pigs which tend to develop too much back-fat the practice minimizes or corrects this tendency. Some experimental work carried out in New Zealand supports this view.

THE GENERAL OBJECTIVE SUMMARIZED

Leafy pasture-growth, especially when not poor in clover, being intermediate in character between non-bulky and bulky classes of feeds, and being suitable for use as a non-bulky feed when not consumed in excess by pigs, may be made a very important and inexpensive part of the rations used in pig-keeping. On the other hand, coarse stemmy pasture-growth, being a bulky feed, has little if any value as part of the rations of pigs Because of the fundamental difference between leafy and stemmy growth the basic purpose of pasture-utilization by pigs should be the provision of leafy growth. This means appropriate pasture-control, which in the case of grazing by the extensive method can be obtained readily by using cattle as the agents of control. In the case of the small paddocks prescribed for the use of sows with young litters and of fattening pigs it is difficult, if not impossible, to maintain suitable control of the pasture-growth by the grazing of pigs only, and it is usually advisable to resort to the mower and to other grazing-stock such as sheep and store cattle as aids to the control of the growth.

ADJUSTMENT OF SEASONAL FEED-SUPPLY TO SEASONAL REQUIREMENTS OF ANIMALS.

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BECAUSE of the differential growth of herbage plants throughout the year and because of weather hazards, the most difficult problem of the stock-raiser is the provision of an adequate supply of feed for every day in the year. Worthy efforts have been made to facilitate the provision of feed, generically grouped under the title of "making two blades of grass grow where only one grew previously," either by better strains of grass, by better methods of sowing, establishing, and managing, by top-dressing, or by other means. While on the whole these have been successful, there are those who have failed to get the best advantage from them, but have nevertheless been able to run stock successfully.

Before proceeding further it may be helpful to set out in tabular form the amount of pasture-growth each month and the feed requirements of different classes of stock each month as a percentage of the total for the year.

Table showing Monthly Production of Grass (Average, Maximum, and Minimum) and Monthly Feed Requirements of Stock—All Percentages of the Total for the Year

Grass-growth				Feed Requirements				
Month	Average.	Maximum	Minimum	Cow giving 300 lb of Butterfat without Change of Live-weight.	Cow giving 200 lb of Butterfat with Changes of Live-weight	Ewe and her Lamb fat at End of Four Months	Ewe and her Lamb fat at end of Seven Months: No Change in Ewe Live weight	Ewe and her Lamb fat at end of Seven Months: Change in Ewe Live-weight.
August ..	2	6	1	10·3	6·2	6·9	6·6	4·1
September ..	5	10	1	11·1	7·9	9·5	8·3	8·9
October ..	15	30	10	10·5	15·8	12·0	9·7	13·2
November ..	25	35	10	9·9	16·6	13·4	10·7	13·6
December ..	20	30	10	9·3	16·7	15·1	11·2	11·2
January ..	7	40	2	8·6	5·0	6·3	10·8	10·7
February ..	5	20	2	8·4	3·6	6·3	9·0	8·2
March ..	8	20	2	8·0	11·4	6·3	10·0	9·9
April ..	4	10	0	7·6	7·8	6·3	6·0	7·6
May ..	3	10	0	4·9	2·8	6·3	6·0	5·0
June ..	2	10	0	5·4	3·2	6·3	6·0	8·3
July ..	2	6	1	6·4	2·8	6·6	6·3	4·2

From the above table it is evident that the high-producing well-nourished animal that does not change in weight requires a distribution of feed that is defined within narrow limits, and subject, for a stated performance, to only slight variations due to warm dry or wet cold weather; that nature on the average provides a distribution of feed that makes no attempt to fit the animal's requirements, even if the average were dependable; and that the average distribution is widely departed from in every month of the year; finally, the animals that do change in weight thereby

change their feed requirements to fit the average pasture-growth, or, more accurately, that changes in pasture-growth cause the animal to adjust its weight accordingly, abundant pasture permits the storing of fat, short rations force the animal to use its body reserves and so to lose weight. In the process of feed adjustment this process might reasonably be placed first.

Using the Animal as a Storehouse.

There is probably no process more widely used nor any so indispensable as this in the feeding of stock. Without it drought conditions would destroy stock periodically in almost every part of the world—lazy or inexperienced stockmen would lose more stock than they reared. It is used efficiently and appropriately to combat short spells of insufficient feed, and on country where it is difficult or impossible to have other reserves, especially where the level of stock-production is low. It is used conveniently and less appropriately on paddock farms, where its mistaken costlessness presents it as an easy substitute for better ways of providing feed. Where animals lose weight they must regain it, and this they do when feed is abundant in spring. Three consequences result from this. First, production-feed that could be sold as fat-lamb carcasses or butterfat is stored as ewe body-weight or cow body-weight. Next, the animal storing weight and producing at the same time eats to stomach capacity, and may consume the spring surplus to such an extent that there is little left for putting by as reserves of hay. A repetition of the process in the following year is thus not prevented. Finally, where stock are hungry for long periods there is difficulty in maintaining good grass, and many of the failures of improved strains and of better methods of utilization are directly due to failure in making adequate feed provision for times of scarcity. On the whole the use of this process should be confined to cheap and natural conditions. Its elimination from conditions of artificial high production would mean the better exploitation of all processes of advanced husbandry.

The Production and Sale of Produce at and during the Peak of Pasture-production.

The natural increase by birth and maximum production of meat or other animal products are everywhere arranged to coincide with the peak of pasture-production. This usually coincides with spring and summer. The selling of butterfat and of fat lambs and all surplus stock by the beginning of early autumn are of similar import in adjusting feed-supply to stock numbers. Appreciation of the part played by the sale of finished produce has lead some stockowners to use the market extensively, wintering as few sheep as possible, stocking up to capacity in early spring, and selling everything that fattens when it is ready. As a national policy it is impossible for every one to pick the plums—if plums they be—in this way, and it is opposed to that stability of progress so essential in all stock projects. Where supplementary crops are grown excessively, the market has to be used excessively. It is probable that most lambs fattened after the end of March in the

South Island are bought lambs, and, since these represent about half of the killings for the South Island, this practice appears to be quite important—a link between the high country and the paddock farms. Whereas the high-country sellers are rightly using the markets to facilitate the adjustment of their feed-production, buyers of store lambs are actually doing the very opposite. They have created an abnormal feed-supply in autumn, and have to buy sheep to eat it. This has two direct consequences—(1) It reduces the area of grass and consequent summer capacity; (2) on most farms the fattening lambs use some grass that would otherwise be ewe-feed, and in so doing often cause shortages of ewe-feed, with consequent poor ability to produce in spring, punishment of grass that makes renewal necessary, and lambs of slow growth that require further supplementary crops.

HAVING STANDING RESERVES OF FEED (KHAKI GRAZING).

Next to the processes outlined above, this is probably one of the most important throughout the world. It is the wild animal's method of wintering, moving from higher to lower levels in winter and oppositely in summer. The nomad introduced some refinement in that he eliminated the factor of topography and grazed wherever suitable feed was to be found. Range grazing in Western United States of America and the grazing of fenced areas at special times in many places the world over are still further refinements. High-country grazing in New Zealand is not dissimilar to the natural grazing by the wild animal. Having standing reserves is the obvious cheap and efficient method of smoothing out the feed-supply under conditions of low production where the country is rough. Its cheapness and efficiency have established it in a modified form as a practice on most paddock farms. Its use here levels out the variations in growth due to variable rainfall, and when it is combined with suitable top-dressing it has been all-sufficient on farms of high-producing capacity. It lends itself to sheep more than to cattle. Sheep have a higher peak production in spring. The amount of spring surplus is therefore less, and not sufficiently generous to warrant its being saved as hay. Dairy cows, with a low peak requirement, leave a surplus that can be cut for hay. Again, sheep are virtually in store condition for six to seven months of the year, whereas cows are thus for three or four months only. Standing reserves may feed sheep adequately while they are not producing heavily, and so provide as much as half the animals' requirements for the year.

Measurements made at Lincoln College indicate the probability that paddocks shut up for three months and grazed at the end of this time provide as much store feed for sheep as they would have provided productive feed if grazed in the young-leaf stage. The selection of grasses that would hold their leaf long past maturity would appear to be a point worth considering where it is desirable to hold large quantities of khaki grazing in reserve.

HAVING RESERVES AS HAY OR SILAGE, ETC.

This is the time-honoured, positively organized method of saving the summer plenty for the periods of winter scarcity. It is a costly safe insurance by comparison with other methods, and a practice

that is steadily growing in New Zealand, the figures for grass, hay, and silage being as follows: 1920, 117,000 acres; 1927, 288,400 acres; 1934, 470,000 acres. The figures for the Auckland Province are even more striking—44,000, 91,000, and 180,000 acres for the years 1920, 1927, and 1934 respectively.

The making of hay is usually more popular on dairy-cow country than where sheep are raised, for the reasons already mentioned. It has no reactions or bad consequences resulting from it, and amongst the processes of adjusting feed-supplies it must be placed first as the most positive, orthodox, and organized of methods. Reserves amounting to 10 tons of hay, of chaff, or its equivalent per 100 ewes for 120 days feeding in winter is about the maximum that is kept, but even this provides only about half their requirements. One ton per cow would be a small amount, yet this should provide all the maintenance for 120 days' feeding.

THE GROWING OF SUPPLEMENTARY CROPS.

Like the saving of hay, this has come to be the recognized and widely accepted method of providing winter feed. Unlike hay, however, supplementary crops, while valuable for their costless-storage attribute, are not capable of being stored for more than a limited time. Again, whereas hay must be always more costly than the grass from which it grew, supplementary crops may be much cheaper than grass when yields are heavy, or they may be very much more costly when yields are light. They are especially grown with grain, or where hay is impossible, usually because of low rainfall. They are often grown for the convenience with which they fit into the grass-renewal practice, but sometimes their being grown too frequently becomes the prime cause of the renewal of grass. The growing of supplementary crops is closely associated with the buying and selling previously discussed.

THE USE OF TOP-DRESSING.

The use of manures was traditionally associated with the production of harvested crops, and was applied to grassland most usually for the production of hay. Manure gives its peak of response about two to three months after application, and for hay-production it was rightly applied in August or September. These months are also the convenient times to apply it on most mixed farms, where team work is slack at this period of the year, and so top-dressing was thoughtlessly and wrongly done at this time of the year. Enlightened farmers appreciated that it often gave a flush of feed when there was already too much, and explored the possibilities of applying top-dressing in other months of the year. Top-dressing has its greatest value when it gives growth in the off-season, and where it is applied in December, January, February, or other non-spring months its proper function appears to be appreciated. If the year is divided into quarters it would appear from observations at Lincoln College that pasture-production is least variable and lowest in the quarter ending 30th September (7 per cent. to 10 per cent. of the year's growth takes place in this quarter). Top-dressing in any other quarter of the year, but more especially in the quarters ending April and July, consistently increase the September yield

up to 14 per cent. to 18 per cent. of the year's growth, and brings it within striking distance of the animal's feed requirements of 18 per cent. to 20 per cent. By top-dressing appropriately as regards time and amount and by the intelligent use of other factors some sheep-farmers in the South Island have profitably dispensed with the growing of supplementary crops. Good grass well sown and well managed is certainly the key to the maximum exploitation of top-dressing.

THE USE OF DIFFERENT KINDS OF GRASS.

While few would dispute the excellence of rye-grass and clover of the perennial types as judged by abundance of yield under perfect management, there are some who recognize the importance of out-of-season grass and have taken steps to secure it. Many of the grasses that have failed to stand up to the hard treatment that is necessitated by occasional spells of dry weather are nevertheless capable of persistence when treated according to their merits, and those that produce out-of-season grass have, for this reason, come into prominence sporadically in many localities. Prairie-grass that disappears from pasture under ordinary conditions persists when grazed appropriately and grows so abundantly in late winter and early spring that some who use it can do without turnips. Canary-grass seems to have the same attributes. Subterranean clover, because of its winter-growing capacity, and because it is not eliminated by being eaten out in periods of dry weather, has advantages over even wild white clover in some localities. The growth habits of red clover, cocksfoot, and paspalum have long been appreciated, and the project of having more or less pure or dominant strains of these pasture-plants in small areas is becoming increasingly important. The development, because of their off-season productivity and the use of what was once considered inferior plants, has doubtless been stimulated by researches into grass-strains, and is destined to become of major importance in the immediate future. If grasses that grow abundantly in the off-season and that possess the property of " store ability " in the paddock to a high degree—usually associated with a coarse-leaved succulence—could be exploited and developed, a very useful work would be accomplished.

USING DIFFERENT KINDS OF STOCK.

Whereas breeding-ewes and dairy cows have a well-defined feed-distribution for maximum production and react most sensitively to reduced supply, dry sheep and fattening cattle can tolerate fluctuations below the normal with less serious consequences. The day that the rams are put out with the ewes determines the week five months later when abundance of feed is required, and unless it is forthcoming—and a late spring is not unusual—then all the care that has been spent on ewes for the whole of the year may be easily undone.

With dry sheep or non-dairy cows a feed-shortage if protracted for an extra three weeks has less serious consequences than with in-lamb ewes, and the former class of animal appears to be an excellent safety-valve to guard against the vagaries of lack of feed in spring. Provided two light hoggets can return 10s. each by way

of wool and price increment for a year's feed, they are just as profitable as a ewe that produces a fat lamb at 20s., since her wool usually goes to offset her depreciation. Where hoggets are kept to replenish ewe flocks they cannot as a rule be used in this way. During the last four years in Canterbury ewe or wether hoggets were as profitable as ewes, but at the present it is difficult to see how they can be with higher winter buying-prices of hoggets and higher prices of fat lambs. There are fewer feed difficulties on a farm that carries 800 hoggets and 400 breeding-ewes than on a similar one carrying 800 breeding-ewes. Similarly, yearling cattle that show an improvement of £3 to £4 in value are as profitable as sheep, and almost as profitable as cows of 200 lb. of butterfat, and, if used as equalizers of feed-supply, they ease the feed position considerably.

SAVING SEED.

Where use has been made of pedigree grass, carefully sown and well established, intelligently managed and top-dressed in relatively small areas where one grass is dominant, the saving of seed is a profitable adjunct to sheep-farming. It appears to have advantages over grain-growing as an association with sheep, because with this treatment grass is helped by the spells of seed-production. Grass is often looked upon as a second string in grain-growing districts, with little attention given to its permanence, establishment, or management.

IRRIGATION.

Irrigation removes the weather hazard from grass-growing and leaves only the hazard of temperature, thus extending the growing-season from perhaps four to eight or nine months. Where irrigation is a possibility, the perennial types of rye-grass and white clover must ultimately attain the fullest expression of their worth.

GRASS-DRYING.

Grass-drying is of interest because of the certainty with which it establishes reserves of high-quality feed. It appears to have become established on a commercial basis in other countries, and to deserve careful attention in New Zealand. In association with irrigation, it should be exploitable to best advantage.

CONCLUSION.

The above considerations have been set out with the object of reviewing the processes commonly in use for adjusting the feed-supply to the needs of the animals. While these processes are often consciously used with skill to achieve the desired object, many use them automatically because it is the custom of the district, and without the skill that is associated with conscious effort. Some use them to their own embarrassment, being forced to make amends for the abuse of one by the wrong use of a second or other process. This is not to be wondered at. It was well illustrated in pigs some ten years ago, when the absence of an adequate winter-feed supplement to take the place of skim-milk forced pig-feeders into the malpractice of paying ridiculous prices in spring for weaners, which they fed to bacon-weights. Both high-priced

weaners and uneconomical feeding of a few were inimical to profits. So now with sheep: Excessive growing of supplementary crops in many places forces farmers to use the markets wrongly, to persevere with bad grass, and so to limit their summer carrying-capacity in a way that is inimical to profits. Finally, appreciation of this review might lead to better co-ordination of scientific effort. Grass is useful only as stock products, and better utilization of better grass by better stock must make more progress than will be made merely by spending all our efforts on better grass and ignoring the other factors. Consideration might even be given to what better grass really does mean, and to whether a selection of vigorous winter-growers with ability to persist by reseeding or other hunger-proof devices, and capacity to store themselves in the paddock in a succulent stage over long periods, may be a matter worthy of better consideration.

EFFECT OF ANNUAL APPLICATIONS OF SULPHATE OF AMMONIA AND SULPHATE OF POTASH ON YIELD OF A PHOSPHATED PASTURE.

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IN a paper presented last year to the Grassland Association Conference attention was directed to an apparent effect of sulphate of potash in overcoming the depression in yield that follows the repeated use of sulphate of ammonia and superphosphate on the pastures at the Marsden Research Farm, Stoke, Nelson. It is the purpose of this article to show how this effect has operated during the past four years.

SEASONAL PRODUCTION.

It will be necessary first to examine the distribution of the yield of dry matter over the season. In Table I data are presented showing the distribution of yield of dry matter for different treatments during the 1935-36 season.

Table I.

Period.	Yield in Pounds of Dry Matter per Acre.		
	3 cwt. Superphosphate.	3 cwt. Superphosphate, 1½ cwt. Sulphate of Ammonia.	3 cwt. Superphosphate, 1½ cwt. Sulphate of Ammonia, ½ cwt. Sulphate of Potash.
24/7/35 to 30/9/35 ..	686	872	907
1/10/35 to 23/12/35 ..	2,628	2,467	2,548
24/12/35 to 20/5/36 ..	2,527	2,453	2,677
Total	5,841	5,792	6,132

It is clear from these data that where nitrogen has been used markedly increased yields were obtained in the first, or early-spring, period, but that later in the season where nitrogen and phosphate only were used the yields fall below those for phosphate only, so that over the whole season the total yield in the former case may fall below that of the latter. On the other hand, when potash was added to the fertilizer treatment the depression in yield in the second period was not so great as for nitrogen in conjunction with phosphate, and in the third period the yield from the complete treatment was actually the highest of all the treatments. For the whole season the complete treatment of nitrogen, phosphate, and potash gave the highest yield. The increase in yield for the season of the complete treatment over that of nitrogen and phosphate has amounted to 340 lb. of dry matter per acre. This increase, together with that of 224 lb. for the third period, was statistically significant.

Now compare the yields for the phosphate and the complete treatments. Except for the initial period when the nitrogen was exerting its full effect, the complete treatment did not show a very marked advantage in yield over the phosphate treatment, the total increase of the second and third periods for the complete treatment being only 70 lb. of dry matter above the yield of the phosphate treatment.

It must be pointed out, however, that the use of potash has very largely overcome the depression in yield shown in the second period under nitrogen treatment, and in the third period the complete treatment shows a statistically significant increase over both the phosphate and the phosphate-plus-nitrogen treatment. It appears therefore that on this Nelson pasture in the presence of potash the depressing effect of annual applications of sulphate of ammonia on yield was not so marked, and that potash acted in the direction of making the distribution of production on the completely fertilized area approach more closely to that on which phosphate only has been used. This is important in Nelson, because any reduction in pasture-production during the summer period has a serious effect in limiting the carrying-capacity of a farm.

Examination of the yield data for the same three fertilizer treatments shown in Table I over the past four seasons yields some interesting results. The requisite data are given in Table II. It is clear from these data that the complete fertilizer has given the best result in terms of pounds of dry matter per acre in all four seasons. If allowance is made for the exceptionally dry season of 1933–34, the increases in yield shown in favour of the complete treatment were appreciable, and almost in proportion to the total yield of the corresponding season. Moreover, except in 1933–34, these increases were statistically significant.

But when a comparison is made of the yields from treatments A and B, it is seen that, except in the first season, decreases in yield, not statistically significant, however, have followed the annual use of sulphate of ammonia in conjunction with 3 cwt. superphosphate. The use of sulphate of ammonia usually on this pasture does not appear to be advisable, even though annual phosphate applications are also provided.

Table II.—Yield in Pounds of Dry Matter per Acre.

Season.	Treatment A.	Treatment B.	Difference B–A.	Treatment C.	Difference C–A.
1932–33	3,869	4,006	137	4,077	208
1933–34	3,192	3,119	73*	3,265	73
1934–35	4,830	4,828	2*	5,052	222
1935–36	5,841	5,792	49*	6,132	291

* Decrease in yield.

NOTE.—Treatment A: 3 cwt. superphosphate per acre; Treatment B: As A plus 1½ cwt. sulphate of ammonia; Treatment C: As B plus ½ cwt. sulphate of potash.

To obtain the direct effect of the potash application, the differences in yield of treatments B and C must be taken. These are given below in Table III:—

Table III.

Season.	Pounds of Dry Matter per Acre: Increase following Use of ½ cwt. Sulphate of Potash per Acre.
1932–33 . ..	71
1933–34	146
1934–35	224
1935–36	340

SUMMARY OF RESULTS.

These data indicate that potash when used in conjunction with a manurial programme involving the annual use of superphosphate and sulphate of ammonia was having an increasing beneficial effect on the pasture, as the increments have increased to a much greater extent than would be expected from the annual totals. As these increases have been obtained in seasons of varying moisture conditions, it would appear that potash has maintained the pasture in a better state of productivity than would have been the case if nitrogen and phosphate only were used for top-dressing purposes. Not only has the use of potash enabled the depressing effect of sulphate of ammonia to be overcome, but, as indicated in Table II, the complete treatment has given materially improved yields over the use of superphosphate alone. This does not mean, however, that the use of a complete fertilizer will be profitable. Indeed, the data indicate that, compared with the cost of 3 cwt. of superphosphate per acre, the complete treatment cannot be payable. But the data show the value of potash applications in promoting an optimum yield of pasture in those cases where sulphate of ammonia is used frequently in addition to a top-dressing of superphosphate.

SUMMARY.

The use of a complete fertilizer gave the highest yield of pasture in mowing-trials at the Marsden Research Farm, Stoke, Nelson.

The use of sulphate of potash at the rate of ½ cwt. per acre overcame the depression in yield following the annual use of sulphate of ammonia on a phosphated pasture.

Where nitrogen is used annually in conjunction with phosphate, application of potash appears to be necessary if optimum yields are to be obtained.

VINE-CULTURE UNDER GLASS.

(Continued.)

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THE STONING-PERIOD.

THE young berries swell very rapidly for several weeks, and then for three or four weeks almost stand still. The berries at this time look very hard, and the cuticle has a tough appearance. This is the stoning-period. During this time the day temperature should be kept down as much as possible by free top-ventilation. The object sought should be to secure as little difference as possible between day and night temperature. No attempt should be made to force the berries to swell, either by feeding the border or syringing the vines. This is the period when attacks of mildew and sun-scald are most likely to occur through wrong treatment, and also it is the time when mildew can do most damage. Opening of the bottom ventilators while there is any condensed moisture on the berries or the leaves must be carefully avoided. The berries swell rapidly again as soon as stoning is completed, this stage being known as the second swelling. When this begins, syringing may be taken up again, and the border may be given liquid manure or water according to its requirements.

THE SECOND SWELLING AND COLOURING.

Thinning the berries, as far as possible, should be completed in one operation. This, however, is only accomplished by those who are experienced in the work and know what the vines they are working on are capable of producing, as well as the size of the berry to expect on different varieties. At least twice as many berries must be removed from Gros Colman as from Black Hamburg. Inexperienced people usually underthin, with the result that the berries soon crush together, rendering a second thinning necessary. In a ripe bunch the berries should touch each other without crushing. A bunch when cut and placed on a dish should retain its shape. If the berries crowd together, and the bunches have a stiff unyielding appearance when the second swelling begins, more berries should be taken out, or the bunches will be spoiled. The thinning should be completed before stoning is complete, but it is better late than not at all.

Soon after the second swelling begins the skin of the berries assumes a different appearance: it seems more transparent, a sign that ripening has commenced. The greatest increase in size is made during this period, swelling continuing until colouring is nearly finished. On this account the border should not be allowed

to become dry. Watering, when necessary, may be freely done until the berries are half-coloured. By the time stoning is complete and the second swelling commences the condition of the whole vine changes: the laterals become woody and the leaves firm. If the conditions in the house are reasonably dry, as they should be, there will be no further danger from mildew. Bottom-ventilation can now be applied. During fine weather what is termed a buoyant atmosphere should be maintained—that is, the air should not be too dry. "Damping-down" may be necessary, but some houses do not require it. Syringing the vines, which at this period is useful in keeping red spider under control, does not injure the bloom on the berries, though it is commonly said to do so: syringing may be continued till colouring is well advanced.

If during the ripening-period any great amount of foliage is removed, it causes a check in the developing fruit. This emphasizes the necessity for timely attention to "stopping" or checking the surplus growth before it has developed to a wasteful extent. Judicious "stopping" fosters the main leaves, which are of the greatest importance, and allows of a free passage for air through the vines. A good canopy of foliage above the fruit is required, but the leaves should not be crowded. If through neglect there is at this time more lateral growth than is advisable, such growth should be left till the grapes are ripe before cutting it out. In the meantime the points of the laterals should be "pinched off" to prevent them advancing further.

THE AFTER-RIPENING PERIOD.

The after-ripening period is an anxious time to many growers of Gros Colman because the berries of this variety often crack badly. It is not an uncommon experience to lose the greater part of the crop from this cause. Madresfield Court, a muscat variety, is subject to the same trouble. This variety, however, is not extensively grown in New Zealand. The skin of the berry of these two varieties is different from that of others in that it is very porous and able to absorb a considerable amount of water. Thus, when the atmosphere of the house is surcharged with moisture, as may occur during wet weather, the berries absorb so much water that, the skin being unable to stretch sufficiently, ruptures are caused. The remedy is to prevent, by judicious ventilation, a still atmosphere about the berries. Some amount of top-ventilation should always be provided by night as well as by day; bottom-ventilation should be given all day, and the doors opened in the warmer parts of New Zealand. An additional reason for a proper control of lateral growths is here provided, for if the foliage is crowded the difficulty of maintaining movement of the air is greatly increased.

These conditions of ventilation are also suitable for keeping grapes of other varieties after they are ripe. Absolutely dry conditions should be avoided, or the berries will not remain plump. In a very dry house a little "damping-down" is advisable. In this matter, however, treatment right in one place may be wrong in another: every house should be treated in accordance with its condition.

Some growers think late lateral growth should be allowed to run free. Such a course tends to keep the vines active too long. This growth should be checked and the vines encouraged to rest as early as possible. The resting-period is very short in this country under the most favourable conditions.

MANURING ESTABLISHED VINES.

The manurial requirements of grape-vines are practically the same as those of most other fruit-trees, but as the vines are planted closely together, resulting in the soil being heavily taxed, manuring must be on a much more liberal scale than in the case of orchard trees. The principal substances necessary are phosphates, potash, nitrogen, and lime. In the case of grape-vines, where liberal quantities are used, it is necessary to be careful that some of the manures are not used in excess.

Lime is of great importance: instances of bad setting and of stoneless berries have been traced to a deficiency of lime. Potash is also of great importance. The most useful artificial potassic fertilizer for vines is sulphate of potash. Animal manures contain some potash, and wood ashes a considerable amount, which, however, is variable. Common artificial phosphates are bonedust and superphosphate; the former is generally preferred for vines. The principal nitrogenous fertilizers in use in New Zealand are nitrate of soda and sulphate of ammonia, both of which are of quick action, though the influence of the latter is likely to be more extended.

Stable manure is considered a complete fertilizer. Its content of potash is somewhat low, and it may contain only a small amount of nitrogen. It is a mistake to apply heavy quantities to the borders; this results in souring the soil, and cases are known where vines have been killed through heavy quantities being used. Good crops have been grown without the addition of other fertilizer when moderate quantities of stable manure have been applied to soils containing sufficient lime. Better results can usually be secured, however, by supplementing stable manure with artificial manures. Cow-manure has been used with good results where the soil is light and warm. It should be used with caution on borders with heavy soil.

The growth of vines in different soils and circumstances varies greatly in character. Where growth is very strong very little nitrogen, if any, is required in the fertilizer, while if growth is weak, or comparatively so, somewhat heavy dressing of nitrogen, preferably in the form of nitrate of soda, may be advisable. The role of nitrogen is to promote vegetative growth: it does this only when a sufficiency of the other elements is present. Care should be taken to avoid the use of too much nitrogenous manures, which is liable to retard the ripening of the grapes.

Briefly, the manuring procedure suitable for general use is: After the vines have been pruned the border should be cleaned up. If a summer mulch has been applied any residual strawy debris should be removed. If weeds are present they should be cleared away. The surface of the border should not be dug, using the term in its ordinary sense, but it may be lightly pointed over with

a fork. If the soil is in need of lime, a dressing of 2 lb. of air-slaked quicklime per square yard should be mixed well with the surface soil. If lime has been applied not more than two years previously, ½ lb. per square yard is sufficient, while, if given regularly every year, 4 oz. per square yard is enough. A month or three weeks before the vines are expected to start new growth a fertilizer, consisting of 2 oz. bonedust, 1 oz. sulphate of potash, and 1 oz. sulphate of ammonia per square yard should be applied and scratched in with a sharp-toothed rake. Just before the vines begin to flower, nitrate of soda, 1 oz. per square yard, should be applied, and later, when the grapes begin to colour, 2 oz. per square yard of sulphate of potash should be applied by being watered in.

Prior to the setting of the berries the surface of the border should be open to the sun. On the other hand, if some protection against sun and wind is not provided during summer the surface soil becomes dried, causing the roots to go more deeply in search of moisture, which is very undesirable. Therefore, when the berries have set, a mulch, about 6 in. thick of rather fresh and littery stable manure should be applied. The fertilizing substances in the manure are washed into the soil by the rain or by watering, and no other fertilizer is needed. If stable manure is not available a dressing consisting of sulphate of potash (1 part) and blood and bone (2 parts) may be applied at the rate of 1 lb. to 2 square yards. With this a mulch of some kind should be provided: this may be spent hops, straw, or any suitable material that is available. Pumpkins or marrows make an excellent mulch when grown from hillocks outside the borders and led over them.

WATERING.

The grape-vine is a vigorous plant, and is expected to carry a fairly heavy crop of soft fruit which contains a good deal of water. If the vines are flourishing the border becomes full of roots, and a liberal supply of water must be assured. Outside borders rarely require watering till the stoning-period is past, and with inside borders watering should be of a minimum character during the stoning-period. It is after this time that the demand for water is greatest. When it is applied it should be in volume sufficient to penetrate the whole of the border. There is no danger of over-watering provided drainage is good. If drainage is not good, it is a defect that should be remedied the following winter. A thorough watering twice a week is sufficient for dry situations. It is a matter for which no hard-and-fast rule can be laid down: each grower must be guided by local conditions. Applications of liquid manure are advisable when the vines lack vigour. These should follow the watering.

VARIETIES.

The appended list is confined to those varieties which already are in cultivation under glass in this country, which have given general satisfaction, and which can be most strongly recommended. It is not suggested that other varieties are not worth growing, but it is claimed that the varieties mentioned supply all needs. The greater part of commercial crops consists of two varieties—Black

Hamburgh and Gros Colman. In some cases, where the vinery is close to a large population, the crop is mostly disposed of direct to customers. In these instances it seems to pay to grow varieties of superior flavour, which, though not producing so heavy a crop, command a higher price, and, further, serve to popularize the establishment. Muscat Hamburgh, Mrs. Pince, and Muscat of Alexandria are among the best that can be grown for this purpose.

BLACK VARIETIES.

Black Hamburgh.—This is the most popular and most widely grown of all varieties under glass. It does well in any form in which grapes are grown—in a cool or a warm house. Bunches and berries are handsome, and flavour excellent. It is to be understood that cultivation, regulation of the crop by thinning to the capacity of the vine, and general management influence the finish, consequent appearance, and flavour of the berries.

Gros Colman.—A thick-skinned vinous grape; berries very large and round. Flavour rather poor when first ripe; after hanging it becomes vinous and agreeable. In this country Gros Colman is the most extensively grown variety for late use.

Gros Maroc.—A very handsome grape when well grown. Berries ovate, very large, pleasantly flavoured, and vinous. Ripens soon after Black Hamburgh, and succeeds under the same conditions.

Madresfield Court.—A muscat, with handsome bunches; large berries of rich flavour. Is liable to crack and to lose colour. Requires similar treatment to that given to the Gros Colman. (See under "The After-ripening Period.")

Muscat Hamburgh (synonym Snow's Muscat).—An oval-berried muscat with rich flavour. Does well grown with Black Hamburgh; ripens soon after that variety. Does not hang long after it is ripe. Vineries should include a rod or two of this excellent variety grafted on 34 E. stock, which controls its tendency to "shank," and improves both crop and fruit.

Mrs. Pince.—A high-class late muscat. Berries medium size, oval or oblong. Skin thick and tough; flesh firm, crackling, vinous, and rich, with a fine muscat flavour. An excellent keeper, though apt to shrivel and lose colour. Requires a warm house in the cooler districts.

WHITE VARIETIES.

Golden Chasselas (Salomon's Selection).—Also known as Royal Muscadine. Flesh juicy, sweet, and firm, growth vigorous and hardy. Ripens early and hangs well.

Foster's Seedling.—A very free bearer of first-class quality grapes. Ripens with the Black Hamburgh.

Muscat of Alexandria.—Late; considered to be the finest-flavoured of all grapes. The oval berries should be golden-amber when ripe. Requires a warm house, but does fairly well in unheated houses in the warmer districts: 420 A. is a good stock for this variety in phylloxera-infested areas.

Pearson's Golden Queen.—A vinous grape; berries above medium size, oval; bunches handsome. A good variety that does well in most places. Season late; hangs well.

(To be concluded.)

CLOVERS IN CANTERBURY PASTURES.

J. W. CALDER. Canterbury Agricultural College, Lincoln.

CROPPING and cultivation under warm and moist conditions leads to a rapid depletion of the organic matter in the soil. In the cropping-areas of Canterbury the depletion of organic matter is of major importance, often responsible for the poor establishment of pastures and the low carrying-capacity of them as well as low yields of crops. Those who have tried to establish pastures on cropped-out lands—*i.e.*, land whose organic matter has been depleted by a period of cropping and its associate cultivation—know how true this is. The fertility of our soils was a heritage of the past, and it is one of the functions of the farmer to maintain or build up the fertility. This can be achieved by adding organic matter in the form of farmyard manure, ploughing in green manure or growing crops including pasture, which are fed off on the field. The organic matter thus added to the soil, whether in the form of plant residue or stock droppings, provides the material for available nitrogen and the nitrogen increases the growth of grasses. The effect of this nitrogen can be seen in the vicinity of stock droppings and urine patches. This is more conspicuous in pastures on cropped-out land and in pastures deficient in clovers. In pastures without clovers such patches do not indicate an increase of nitrogen on the field, but rather a concentration of it. Legumes, however, build up the nitrogen content of the soil either through their residues or through dung and urine of grazing animals. Recent work with legumes has shown that the nodules also excrete nitrogenous compounds in the soil, and these compounds may be directly available to associate plants. An experiment by I. D. Blair has proved interesting in this respect. Rye-grass tillers from a single plant were planted in pots filled with sand washed free of nitrogen. Some were grown with white clover inoculated with nodule bacteria, others with white clover the seed of which was surface-sterilized and not inoculated. They received a nutrient solution minus nitrogen. Others were grown without the clover association and received a nutrient solution containing sodium nitrate, or sulphate of ammonia. The clover-seed was sown in the same pots two months before the rye-grass tillers were planted to allow the clover-plants to become well established and nodule bacteria to function. The development of the rye-grass after fifteen weeks (May 14th to September 1st) under these different treatments is shown in the following table :—

Table showing the Development of Rye-grass growing in Nitrogen-free Medium and treated with (a) Nutrient Solution containing Nitrogen, or (b) Nutrient Solution minus Nitrogen but growing with Inoculated or Non-inoculated White Clover.

—	A (Nitrogen).		B (Minus Nitrogen).		
	$NaNO_3$.	Sulphate.	Inoculated White Clover.	Non-inoculated White Clover.	Control.
Number of rye-grass tillers	134·0	188·0	142·0	7	50
Number of plants ..	20·0	20·0	5·0	5 (2 dead)	5 (all dead)
Average number of tillers per plant	6·7	9·4	8·4	1·4	..

This experiment indicates that white clover is capable of supplying nitrogen in an available form to rye-grass growing in association with it, and suggests the importance of establishing clovers in pastures as early as possible. Nitrogen is made available in the soil for grass-growth from at least two important sources: (*a*) the organic matter—this does not increase the nitrogen-content of the soil unless it be from leguminous crops; and (*b*) direct from growing legumes. The available nitrogen encourages vigorous grass-growth, and this when fed off adds to the organic matter in the soil, and the fertility of the soil is built up.

Calculations of the amount of nitrogen added to the soil by clovers in pastures have been made, and the amount varies with the clover and the soil conditions. In working with subterranean clover at the Waite Institute in South Australia, it was found the two successive crops of two tons each, if grazed, enriched the soil by approximately 108 lb. of nitrogen, equivalent to 5½ cwt. of sulphate of ammonia. Think of this on our light land or on cropped-out fields. Nitrogen free of cost (or probably at the cost of annual dressings of superphosphate and lime); extra grass-growth; extra stock grazed; extra organic matter; extra fertility. There is naturally a limit to the improvement that can be made in the fertility by these means, but on some of the cropping lands of Canterbury that limit is worth aiming at.

The general benefits of clovers in pastures are well recognized, and the majority of the mixtures sown contain clovers; but how many on the cropping-lands of Canterbury are satisfied with the amount of clover that comes from the sowings, particularly in the first few years in the life of a pasture?

Factors influencing Clover Content of Pastures.

The first requirement is to sow the seed. This may appear to be an unnecessary statement, but it refers to white clover. Many pastures are sown without white clover, not because farmers do not appreciate the value of white clover, but because they have sown white clover and it has not established, or they have observed white clover coming into their pastures in the third or fourth years. They are content to rely on the so-called natural white clover in the land or that brought in by sheep. There is no doubt that there are areas where the land contains white-clover seed and this seed is likely to establish in a pasture, but there are thousands of acres on the plains where reliance on such natural clover results in a clover-deficient pasture. The value of establishing clover in the first year has been mentioned, and one can have a reasonable chance of achieving this object only by sowing the seed. This, in itself, however, is not sufficient, and the other factors which influence the growth of clovers must be considered also.

The strain of clover sown has an important bearing on the clover content of the pasture. In the case of white clover the certified strains of New Zealand wild white clover have proved their own superiority for long-duration pastures over the ordinary commercial lines. In the case of red clover, it is well known that this valuable summer and autumn grower lasts only two years or so on the medium to light lands. The Montgomery red clover is a more persistent strain, and, while there are not many stands of this clover on the medium to light soils, the indications are that it will last one or two years longer on this class of land than the ordinary commercial red clovers, and is well worth

including in mixtures on such land. In regard to subterranean clover, from observations on some of the Australian strains and on the field establishment of some of the commercial lines it appears that strains more suitable for particular conditions can be isolated.

A third factor of importance is lime. Soils without sufficient lime are usually sour, and sour soils do not grow clovers. A number of common weeds grow well on sour soils, particularly sorrel and spurry. It needs only a trip through Canterbury in summer-time to see the thousands of acres of red flowering sorrel which bear evidence to the sour condition on many areas. A certain degree of lime-deficiency does not necessarily restrict the growth of grasses and cereals, and the application of lime has not resulted in marked response to the growth of these plants in many areas in Canterbury, with the result that liming has not been widely adopted in Canterbury (8,000 tons in 1933–34, compared with 60,000 tons for Southland). But on most soils in Canterbury a marked clover response is obtained. It is from this aspect that the liming must be considered. We must grow clovers in our pastures, and in order to achieve this object economically we must add lime. On pasture-lands up to 1 ton per acre can be put on as a foundation dressing. At Lincoln a pasture mixture was sown in December in a field half of which had been limed twelve years ago at the rate of 2 tons of carbonate of lime per acre. The mixture consisted of 25 lb. of perennial rye-grass, 7 lb. of cocksfoot, 3 lb. of red clover, 2 lb. of wild white clover an acre, and 1 cwt. of superphosphate an acre is applied to the pasture in the autumn. In the first three years the effect of the lime on the grasses was not noticeable, but the effect on the clovers was striking—both on red and white. An analysis of the pasture in the second autumn—*i.e.*, when the pasture was fifteen months old—is given in the following table:—

Table showing the Effect of Lime applied Twelve Years previously on the Establishment of Clover sown in a Mixture

—	Pasture Fifteen Months Old.	
	Lime.	No Lime.
	Per Cent.	Per Cent.
Rye-grass	60	90
Cooksfoot	5	5
Red Clover	20	4
White Clover	15	1

To-day (July, 1936) there is little clover on the unlimed half, and the grass is winter-burnt and fibrous-looking, while on the limed half there is a good mixture of clovers and the grass is green and luscious. When sheep are turned on the plots they graze the clover sward in preference to that without clover. This trial demonstrates the lasting effect of a heavy initial dressing of lime under Canterbury conditions.

The time of sowing also influences the amount of clover in our pastures. Clover seedlings are frost-tender. In the second- and third-leaf stage they are subject to frost-lift, particularly when the ground is wet, and therefore the seed should be sown early enough for the

plants to become well established before the heavy frosts set in. Nearly all our clovers are sown with rye-grass, which is a vigorous grower in its early life and may soon form a smother to retard the development of the associate clovers. When sown by itself clover will establish well on a good seed-bed as late as the end of March, but when sown with rye-grass as late as this the rye-grass establishes well, but the vigorous rye-grass retards the development of the clover, which is then subject to frost-lift. In a monthly sowing trial conducted at Lincoln a mixture of rye-grass, cocksfoot, and red and white clovers was sown at the beginning of each month from October to April. In the following autumn counts were made of the number of red-clover plants in each sowing, and the results are given in the following table :—

Table showing the Effects of Time of Sowing on the Establishment of Red Clover when sown with Rye-grass.

Date of Sowing.	Average Number of Red-clover Plants per Square Yard.
October–December	63
January–February	16
March–April	2

Now, many of our pastures in Canterbury are sown in March after a cereal crop, and it is suggested that this late sowing is frequently one of the major factors responsible for paucity of clover in the pastures, although the rye-grass may establish perfectly well even though sown as late as May. The ability of the rye-grass to establish in the late autumn often disguises the poor establishment of the clovers, and it is not until the second autumn that the absence of clovers is noticed.

Once having got clover established in the pasture by a combination of the factors mentioned—sowing the seed, sowing the right kind of clover, liming the ground, and sowing early—the amount of clover, particularly white clover, may be influenced by the grazing and manurial treatment. The clover is a poor winter grower, and starts growth later in the spring than does rye-grass. When the pasture is spelled in winter and early spring the rye-grass gets a start on the clover and suppresses it to some extent. Conversely, when pastures are grazed closely in winter and early spring, the close grazing prevents a dense rye-grass smother and gives the white clover a chance to develop, and may even allow too much clover to develop. Some of our pastures are subject to this treatment, especially where supplementary crops are a failure or not available. When the close grazing in early spring is associated with liming and autumn top-dressing with superphosphate, too much clover may develop. Farmers who get too much clover are indeed fortunate. They have the fertility building element. They can now proceed to reduce the amount of clover by encouraging the growth of grass by spelling in early spring and by applying soluble nitrogenous fertilizers. But, with the permanent strains of rye-grass and with intelligent manuring and grazing-management, too much clover will not be a common complaint in Canterbury pastures.

PASTURES AND PIG-FATTENING.

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AT the 1935 meeting of the New Zealand Grassland Association McMeekan read a paper on the nutritive value of pastures in pig-raising, and, in respect to fattening pigs, stated that grass "is not capable of materially reducing the total requirements of other food except under a low plane of feeding, the successful practice of which is dependent on economic considerations": he gave details of two feeding trials which showed that "no measurable amount of nutriment was derived from pasture by the pigs in these trials, no significant difference either in growth-rate or in economy of food-consumption being apparent."

During the 1935–36 season a trial of a similar nature was conducted at the Ruakura Farm of Instruction, Hamilton, and a comparison made between baconers fattened in a sty and baconers fattened in cow pastures. The results were as follows:—

(1) *Growth-rate*: Pigs grazed on cow pastures showed a daily increase in dressed weight of 0·88 lb. and the sty pigs 0·89 lb.

(In McMeekan's experiment quoted above "grass" pigs showed a daily increase in dressed weight of 0·75 lb., and "no grass" pigs 0·76 lb.)

(2) *Economy of Food-consumption*: Pigs grazed on pastures required 564·5 gallons of separated milk per 100 lb. gain in dressed flesh and sty pigs 561 gallons separated milk.

(In McMeekan's experiment quoted above "grass" pigs required 533 gallons of separated milk and 18 lb. pollard per 100 lb. gain in dressed flesh, and "no grass" pigs 515 gallons of separated milk and 17 lb. pollard. In comparing the above trials it is to be noted that McMeekan's trials started with pigs of 40 lb. live-weight at the beginning and ended with pigs of 200 lb. live-weight. The Ruakura trials started with pigs of 73 lb. live-weight and ended with pigs 180 lb. live-weight.)

The information available shows that grass does not supply much actual food for fattening pigs; the same is probably true of special grazing crops such as lucerne, red clover, and white clover. The dairy-farmer's problem is to provide farm-grown food when grass is short: when there is plenty of grass there is plenty of milk and when there is no grass there is no milk. His problem is to balance the supplies of pigs for fattening to supplies of separated milk—no easy matter, as can be seen by the production of bacon pigs instead of porkers. Generally it is an actual shortage of pigs that induces the farmer to carry on pigs to bacon weights rather than waste separated milk. Although many farmers consider that the wintering of pigs is unprofitable, it is frequently found that the most successful pig-farmers do winter pigs—wintering them on farm-produced feeds. Connell(1) has stated that the farmers in the Manawatu district who are securing the most satisfactory returns from pig-meat production are those who make considerable use of

farm-grown feeds other than dairy by-products. He suggests the production of special crops for pig-feeding — mangels, carrots, swedes, barley, and field peas. Investigations in Auckland show that the most profitable returns from pigs are secured on dairy-farms in the Bay of Plenty where maize is grown. If provision is made for wintering, pigs need never be sold in a store condition: selling unfinished pigs in the autumn and buying stores or weaners in the spring does not lead to profitable pig-keeping.

The actual provision of root and grain crops for pigs on dairy-farms is not a simple matter. The tendency is to all-grass farming, and, with good pastures, all-grass dairy-farming is quite profitable. The problem appears to be to find a suitable grain or cash crop that can be grown in rotation with roots and green crops for supplementary feeding—a crop that will bring in sufficient money to pay for all the cropping. In South Island rotational farming the cereals provide the cash that allows of the production of turnips and rape for fat-lamb raising. In the Bay of Plenty maize for sale and for pig-feeding allows of the cheap production of swedes for the winter feeding of the dairy herd; in South Auckland the production of early potatoes allows of the cheap production of mangels and carrots for the same purpose; in the Manawatu peas and barley do likewise. Until adequate provision is made for the autumn and winter feeding of pigs, any further investigation of the value of grass, lucerne, or red clover as a supplement to separated milk hardly appears to be warranted.

REFERENCE.

(1) R. P. CONNELL: "Special Crops for Use in Pig-keeping," *N.Z. Jour. of Agric.*, April, 1936.

TYPES FOUND IN COMMERCIAL CRESTED DOGSTAIL.

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IN crested dogstail there is a great variety in the type of plant which goes to make up any sample. Similar variations occur in other plants and have been recorded. It is intended to record here briefly the variations that occur in dogstail to bring it into line with plants that have been more intensely studied.

This variation in growth-form is observed between different lines, but the variation within any of the New Zealand commercial lines is greater than that between the averages of the lines themselves. There is variation in leafiness, earliness, shape of inflorescence, persistence, and, probably, root development. The variability from plant to plant is so great that one has difficulty in finding two similar plants among thousands of spaced plants from the same line. The type, then, as we see it in mass, represents an intermediate point somewhere between the extremes of the different characters. What we are accustomed to consider a feature of any one sample under observation is merely an accumulation of various features associated together to give a superficial resemblance to

that character. It is only when these plants are studied singly and the points of each analysed that we get a true conception of the extent of variability of any one character. From such an approach it is easily seen that modification of environment, be it climatic, biotic, or cultural, can bring about a profound change in the centre point of the observable characters by causing a modification in the incidence of the various forms, even without any actual structural change having occurred in the plants themselves. Thus has been brought about the variation in the lines of dogstail from different countries. The complexity of environmental factors acting on the mass is responsible for the differences observed and described. It is of interest to connect the climatic and cultural conditions affecting the types when considering the characters of each. The types dealt with below are—(1) New Zealand commercial, (2) Irish commercial, (3) roadside and permanent pasture, (4) selections from New Zealand commercial, (5) Kentish, (6) Scotch, (7) Dutch.

New Zealand Commercial.—This type represents the extreme for quick development from seed and earliness of growth. The growth (when seeds are autumn-sown) in the first autumn, winter, and spring is good, but there early develops a stemminess so that palatability falls away soon after active spring growth commences. When the plants are allowed to develop seed-heads, the check to growth is great and summer production is practically at a standstill. There is little activity until after the autumn rains unless the soil is moist, when production may continue through the hot period. Winter growth is rather better than that of Kentish lines. This is the first of the types to flower.

Irish Commercial.—The Irish samples tried out here follow the New Zealand commercial lines very closely in type. This is not to be wondered at, as much New Zealand commercial seed has been sown in Ireland for seed-production purposes and is harvested in a similar way.

Roadside and Permanent Pasture.—Seed was collected from various roadsides and pastures where dogstail was growing strongly and was well represented in the sward. Such seed germinated more slowly, the resulting plants were somewhat more leafy, but later in starting growth in the spring than the commercial samples. When once established, however, they outyielded the commercial types fairly considerably by the end of the first year, and gave a better winter production. They flowered from three to seven days later than the commercial lines.

Table I.—Yield : Seed sown April, 1933

Origin.	October, 1933.	December, 1933.	May, 1934.
Commercial	100	100	100
Roadside and permanent pastures ..	90	108	146

Selections from New Zealand Commercial Lines.—Where selection has been carried out with a view to increasing permanence and leafiness, the end point shows little or no improvement over the

roadside and permanent pasture plants. It would appear that there is a certain amount of selection going on in the permanent swards, and that as a consequence the very early flowering types are not well represented. This group flowered from two to six days after the commercial controls.

Kentish.—Here a big change in type is noted. The seeds are much slower to establish, and in consequence the autumn and early-spring growth-rates (when autumn-sown) are much below that of the commercial lines. Growth proceeds longer into the early summer, and the Kentish permanent-pasture lines were from seven to ten days later in flowering than the controls (New Zealand commercial). Their rate of autumn growth, combined with their close crown and abundance of fine narrow leaves, gives them a better appearance than the controls in April. By mid-winter and at the commencement of the active spring growth, the rate of growth of established plants is somewhat below that of the controls. These English lines are undoubtedly more persistent and leafy than the New Zealand commercial ones, but slower in growth.

Scotch.—Only two samples have been tried out, and these proved to be similar in type to the Kentish.

Dutch.—In respect of time of growth and growth characters, the Kentish lines can be regarded as only intermediate between New Zealand commercial and Dutch. The Dutch lines represent the extreme for slow growth from seed and lateness of spring production, there being a difference of fourteen days between the appearance of flower-heads of the earliest New Zealand commercial and the latest of the Dutch lines. Their winter production, too, is the lowest of the types tried out.

A CONSIDERATION OF THE VARIATIONS DESCRIBED.

The New Zealand types (1, 2, 3, 4) can be grouped together when considering the cause of the development of their specific characters. It seems very probable that when dogstail was first introduced into this country it was of the Kentish or Dutch type. Certain ecological factors began to work, and a distinct type is now present in roadside and permanent pastures from the original introduction. The types which were most suited to the environment came to be represented in greater numbers, so that although there are doubtless most of the original variants present, yet there has been a shifting of the centre of the aggregate of the observable characters. Owing to the greater competition from quickly growing grasses in this country, the smaller, slowly growing, fine-leafed, longer-lived strains have been at a disadvantage. Consequently a stemmy, broad-leaved, early-producing type has predominated which, incidentally, is not very persistent.

In addition to this natural move towards a less leafy but early strain, the method of harvesting the seed which was current until recently has helped to accentuate this character still further. Stapledon, Davies, and others have frequently shown that commercial lines of grasses tested at Aberystwyth and elsewhere have invariably developed parallel tendencies.

For some years dogstail-seed in New Zealand has been harvested from one year and sometimes two year leas. The seed was autumn-sown, and in the following summer a seed crop was taken. Seldom was it left down for two years, owing to the fact that the yield of seed in the second year was poor and weed-growth became unduly strong. This in itself is, as we know, a retrograde step as far as pasture-seed production is concerned. In addition, however, New Zealand got an illicit fame for the brightness of her dogstail-seed. It was definitely favoured on the English market at the expense of the darker local and other imported lines. It generally has been considered by farmer and seedsman alike that a bright seed-sample denoted good harvest weather. The fact is, however, that dogstail ripens best where dull and even damp weather prevails at harvest, and in this respect is the complete reverse of rye-grass. What it really denotes is immaturity, as the best seed is a rich medium brown colour. Stapledon, when he visited New Zealand in 1928, notes this and wrote: "The association of brightness with presumed excellence is indeed a striking example of one of those seed characteristics which have come to have a trade value for no good reason and without the backing of any reliable tests or evidence for its justification."

In an endeavour to get such a sample it was necessary to harvest on the early side; thus the leafy, slower-growing, late producers were unable to ripen the bulk of their seed in time to be included in the seed harvest, and became more scarce. The selections from New Zealand commercial, roadside and permanent pasture plants can be classed as representing more or less the indigenous type. There is no doubt that they are more productive and rather later-flowering than the commercial strains. The type of artificial selection that has been carried on to increase leafiness and permanence in commercial lines has its parallel in the natural selection that is taking place in the field, and lies mainly in the direction of discouraging the very early producers, and consequently increasing the proportion of late producers. Thus one would expect an improvement of type by reversion to the stripper for harvesting the seed where, in the main, seed from the late producers is obtained while seed from the early producers tends to be omitted rather than increased.

The harder winters experienced in England engenders more noticeable falling-away of growth during winter-time. As no premium has been placed on earliness of growth (as has been shown to occur with New Zealand commercial samples) the type is later in developing both from seed and in spring. On account of this fact also, it persists better into the summer. The character of earliness appears to be linked with a broad leaf and stemmy growth as opposed to the narrow and more leafy habit of the later-flowering plants. It is possible to draw a parallel between Kentish wild white clover with its slower growth and finer leaf and New Zealand white clover with its more vigorous habits and larger leaf.

Dutch.—This represents the extreme opposite of the New Zealand commercial. The differences displayed by Kentish are still further

emphasized here. Winter growth is poor, and for a short period in mid-summer it is as productive as any of the others, but for the remainder of the year growth is less than the other lines. The harder the winter conditions the plants have to withstand the smaller is the annual production, but, treating the lines as a whole, the slower the growth the more leafy the plants are. This type from Holland, though excellent in many respects, is too slow in growth to warrant its extended use in this country.

RECENT REGULATIONS AFFECTING FARMERS.

AGRICULTURE (EMERGENCY POWERS) ACT, 1934.

THE Dairy Factory Supply Regulations, 1936, which came into force on 25th September, confer on the Executive Commission of Agriculture all necessary powers to carry into effect as far as possible by voluntary negotiation with dairy-factory companies concerned certain recommendations contained in the report of the Dairy Industry Commission on its investigation into the dairy industry in 1934 and relating to cancellation of cream-receiving depots in certain circumstances, the elimination of competition for supplies of milk or cream, and the minimizing of overlapping in the collection of supplies by the zoning of suppliers, by defining collection routes, by arranging for the amalgamation of companies, and by encouraging the making of boundary agreements between companies.

If the Commission is satisfied after full investigation that any creamery or creameries established in any particular locality is or are adequate and suitable for the manufacture into butter of all the cream produced in that locality, the Commission may direct that from a specified date all such cream should be weighed, graded, and tested only at the creamery wherein the cream is to be so manufactured, and that the registration and license of all cream-receiving depots in the locality should be cancelled. Upon cancellation it shall not be lawful for any person to receive or accept at any such depot cream intended for manufacture into butter.

The Commission is empowered to define and assign to the owner of any specified creamery any area or route from or along which cream produced in such area or along or adjacent to such route may be collected or received by such owner for the purpose of being manufactured into butter; to assign any such area or route or portion of such area or route to the owners of two or more creameries subject to such conditions as the Commission may consider reasonable; to fix a date upon which any such definition and assignment shall take effect and to give notice thereof to the owners of all manufacturing dairies thereby affected. After the date on which the definition and assignment of any area or route or portion thereof takes effect, it shall not be lawful for the owner of any creamery to whom notice of such definition has been given to collect or receive any cream produced in such area or portion thereof or along or adjacent to such route or portion thereof except with the written consent of the Commission and subject to such conditions as the Commission may impose. The Commission is similarly empowered to define and assign with the like consequences any area from which all whole milk produced therein may be delivered to and accepted by the owner of any specified manufacturing dairy for the purpose of being subjected to any process of manufacture other than treatment for sale for human consumption as liquid milk or cream, or to assign any such area or any portion thereof to the owners of two or more such manufacturing dairies subject to such conditions as the Commission may consider reasonable.

When by reason of the exercise by the Commission of the power to define areas and routes a co-operative dairy company is not permitted to continue to receive milk or cream from any shareholder supplier, the company, at the request of the supplier, must, unless the Commission otherwise directs, resume all shares held by him to the number necessary to qualify for the milk or cream supplied during the last season of supply and pay the supplier the amount of capital paid up on such shares. Where moneys have been advanced to any supplier by the owner of any manufacturing dairy on terms of repayment with interest by way of deductions from moneys payable by the owner of the dairy for milk or cream supplied, and where as a result of any determination of the Commission the milk or cream from that supplier must be delivered to or collected by the owner of another manufacturing dairy, then the latter owner, if he does not contract with the former owner for an assignment of the right to receive payment of such advance and interest thereon, must make such deductions as may be agreed upon by the parties from moneys payable by the latter owner to such supplier and pay the amount of the deductions so made to the former owner. If any dispute or difference shall arise as to the amount of the deductions to be made the matter shall be settled by arbitration in the manner prescribed by the Arbitration Act, 1908.

As a condition of exercising its powers the Commission may fix and award to the owner of any manufacturing dairy that the Commission considers will be prejudicially affected by the exercise by it of such powers such sum by way of compensation as it thinks fit or as may be agreed upon, and may specify the owner or owners of the manufacturing dairy or dairies that the Commission considers will be benefited thereby by whom the amount so awarded shall be paid and the portion to be paid by each owner if there are more than one. The Commission may make such stipulations and conditions as to the time, method, and terms of payment as it may think reasonable, and the amount of compensation so awarded shall be recoverable as a debt.

Nothing in the regulations affects the right of any supplier to supply either whole milk or cream to any manufacturing dairy, but in the exercise of his option the supplier shall not transfer his supply except in conformity with the provisions of any Act or regulations governing the transfer of supplies. The period of restriction on the transfer of supply imposed by the Dairy Suppliers Regulations, 1936, in cases where a purchase or merger of factory companies is effected, or where a boundary agreement respecting supplies is made between factory companies during any manufacturing season, has, however, been extended to the end of the manufacturing season following a period of three years from the date of such purchase, merger, or agreement, or from the date of any order or determination of the Commission made under the regulations. In consequence, the Dairy Suppliers Regulations, 1936, are revoked.

As incidental to the due exercise of the powers conferred by the regulations, the Commission is authorized on its own motion or on application made to it to revoke, modify, amend, or vary any order, determination, notice, or other act made, given, or done by it pursuant to the regulations, and in any inquiry that it may undertake in pursuance of the regulations the Commission may associate with it in an advisory capacity one or more members of the New Zealand Dairy Board.

THE PRIMARY PRODUCTS MARKETING ACT, 1936

The Dairy-produce Export Prices Order, 1936, made under section 20 of the above Act, carries into effect the several public announcements that have been made with regard to the prices to be paid for butter and cheese acquired by the Crown pursuant to Part II of the Act, being butter and cheese manufactured from milk or cream delivered to a dairy factory on or after 1st August and exported from the Dominion on or before 31st July,

1937. In addition to the fixation of differential prices according to kind, grade, and quality of the dairy-produce, the appropriate price payable for butter is varied to authorize payment of 3d. per box less for butter packed in the Saranac box, the thickness of timber of which is less than $\frac{3}{8}$ in., $\frac{1}{4}$d. per pound more for unsalted butter manufactured in quantities at the request of the Primary Products Marketing Department, and $\frac{9}{32}$d. per pound more for unsalted butter so manufactured if wrapped in aluminium foil of the prescribed thickness and backed on both sides with genuine vegetable parchment paper of the prescribed weight. In the case of cheese, payment is authorized of an additional sum of 6d. per crate for commercial standard-coloured cheese, 1s. 5d. per crate for deep-coloured cheese manufactured in quantities at the request of the Department, and 4½d. per crate for waxed cheese where the quantity of wax used on each cheese does not exceed 4 oz. The question whether any cheese has been so coloured or waxed as to earn the additional premium shall be determined by the Grader, whose decision shall be accepted by all parties as final. Authority is also given to make a deduction of an amount per box of butter or crate of cheese to cover the portion of the insurance premium payable on such produce prior to shipment pursuant to a contract of insurance over the produce whilst in the process of manufacture or in transit. The method of computing the weight of butter and cheese for the purposes of payment is set out in detail, and follows the established practice in the trade in past seasons as incorporated in f.o.b. contracts. The price to be paid for butter or cheese which with the approval or at the request of the Department is manufactured, prepared, or packed for export in special containers or in special quantities, or in any other special manner, shall be the appropriate price fixed by the order increased by the additional cost incurred in such special manufacture, preparation, or packing as approved by the Department.

STOCK ACT, 1908.

By the Stock (Johne's Disease) Regulations, 1936, which came into force on 11th September, an Inspector under the Stock Act is empowered, where he is satisfied or has reasonable grounds for suspecting that Johne's disease exists among cattle on any land, to make arrangements with the owner for an inspection and examination of his cattle, such examination to include the application of the Johnin test. If any animal reacts to the test its destruction may be ordered, and if destroyed the owner will be entitled to compensation in terms of the Act. The regulations also make provision for regulating the shipment of dairy cattle from the North Island to the South Island. No dairy cattle shall be shipped to the South Island except in pursuance of a permit granted by an Inspector after such cattle have been examined and tested by a Government Veterinarian and found to be free from disease. Application for permission to ship any dairy cattle must be made in the first instance to the Inspector of Stock for the district in which the cattle are depastured, and if on examination any animal reacts to the Johnin or other test its destruction may be ordered, and, if destroyed, compensation for such destruction will be payable. If on examination the cattle are found to be free from disease, a permit in the prescribed form authorizing shipment will be issued.

—*A. E. Morrison, Solicitor, Department of Agriculture, Wellington.*

The Instructor in Agriculture at Timaru reports that a farm at Kingsdown has a field half sown in oats last spring, and half later sown in rape. A pasture mixture was broadcast over the whole area at time of sowing rape. On the oat ground the only take consists of rib-grass and catsear. On the rape portion quite a good sole of grass shows.

BERRY-FRUIT CULTURE.

THERE has been a marked increase in the quantity produced and the realizations obtained for all classes of berry-fruits. This increase may result in a more extensive planting of these classes of fruit. The following come within the scope of the public taste—viz., strawberry, raspberry, gooseberry, loganberry, and red, white, and black currants.

Production is at present confined to specifically defined areas; more especially does this apply to raspberries and currants. Climatic and environmental factors are responsible for this. Given favourable conditions of both soil and climate, proximity to a large centre of population, and a supply of pickers at the harvesting period, any one with limited means could embark on the production of one or more of these fruits in a small way, at first, and then extend the area under berry-fruits as the demand increased. The ease of propagating any of the varieties of the berry-fruits beforementioned is such that further extension of area can be brought about with little extra expense.

Whilst the chief demand to-day for these fruits is for jam-making, either factory or home manufacture, the quantity used for dessert purposes is relatively small A more recent development, the demand for fruit-juices, opens up a much wider field, and it is possible that business of some magnitude in this direction may eventuate. The manufacture of fruit-juices is of some economic importance to the grower, inasmuch as it may obviate the risk of market gluts, and losses which occur through the quick ripening or the hold-up in picking due to unfavourable weather conditions.

—*H. F. Frost, Orchard Instructor, Masterton.*

Mammitis.—Speaking generally, the incidence of this disease has not increased during the year Evidence of increasing confidence in the adoption of hygienic methods of control in the milking-shed is observed amongst dairy-farmers The number of farmers who continue to avail themselves of the service provided by the Wallaceville Laboratory and the subsidiary laboratory at Hamilton, in the regular examination of milk-samples in the mammitis-control scheme, is an indication of appreciation of its application. The present-day outlook on this disease is more reassuring for those who take the trouble to adopt definite control practice. In the absence of any recognized curative properties in vaccination, hygienic control methods must be looked upon as affording a large degree of protection. The disease, however, is one which fully justifies intensive research —*Annual Report, Director, Live-stock Division*

SEASONAL NOTES.

THE FARM.

Forage Cropping of General Importance.

A FAIRLY common mode of reasoning is exemplified in the following statement: During the past ten years or so Mr. X has changed from a sick to a strong man; during that period Mr. X has consumed no milk or eggs, therefore milk and eggs are of no value in promoting strength. This serves to illustrate the fact that correct conclusions are not always drawn from correct information. Of this same fact farming provides an illustration which is of interest at present. On certain farms during the past ten years or so production has increased greatly, cost of production has decreased appreciably, and during the same period there has been a decrease in the amount of special forage cropping carried out on these farms. From these facts it has been concluded that forage cropping should not be carried out. From these facts such a conclusion is quite unjustified. There may, of course, be other facts which justify the conclusion, but the facts given certainly do not do so, although they seem to be the facts upon which some come to a decision. Just as eggs and milk may have made Mr. X still stronger, so additional special forage cropping may make certain efficient farms still more efficient.

The special-forage-crop position warrants consideration largely because of the success which has attended such practices as top-dressing, silage, and systematic grazing. Recent years have been marked by increased knowledge of and better application of our increased knowledge in regard to grassland, and it is highly desirable that our efficiency in respect to grassland be not only maintained, but also improved. To recognize the value of other crops which give assistance in grass-farming is in no way inconsistent with an appreciation of the truly dominant role of pastures in our farming. Top-dressing, suitably controlled grazing, ensilage, all are of great proved value, but to obtain the greatest possible benefit from them it frequently is necessary to adopt other practices such as special forage cropping—in short, there are several links in the chain of factors which, acting together, tend to beget the fullest efficiency.

Special Forage Crops not always Advisable.

While the forage cropping of the Dominion profitably could be increased greatly, it needs to be kept in mind that it may not be advisable at times to grow special forage crops to supplement the pastures; some farmers work under disabilities, and these disabilities may be such as to make the growing of special forage crops of doubtful value. In the main, these disabilities relate to one or more of the following matters: Soil in respect to either its texture or its surface, weed-invasion, and, occasionally, but not as often as seems generally to be believed, labour. For instance, all of a farmer's land may be so heavy in texture and so poorly drained that he has no assurance of being able to provide a satisfactory seed-bed at the time when it is required for success. To take the other extreme, the soil may be so sandy as to be subject to the danger or erosion of "blowing" during windy weather. Again, in a few unfortunate districts the Californian thistle may be so strongly entrenched as to make ordinary forage cropping inadvisable. And, again, some farms are so broken in surface as to be without suitable arable areas. These may be taken as typical of the main disabilities which at times rule out the economic success of arable forage crops. Fortunately these disabilities are not of such frequent occurrence as casual

consideration may seem to indicate ; for instance, adequate areas eminently suitable for special cropping are often to be found on farms consisting chiefly of either very sandy soils subject to blowing or heavy poorly drained soils. That good farmers working under disabilities relative to arable cropping realize that they are handicapped at times is rather well illustrated by the instances in which they obtain, sometimes with considerable difficulty, areas suitable for arable cropping to be used as one farming-unit in conjunction with their properties on which arable cropping is so difficult as to be impracticable.

An Alternative to Arable Cropping—Ensilage and Haymaking.

An important matter that requires careful consideration is the possible alternative to arable cropping consisting in the conservation of enough silage and hay from permanent pastures to suffice for the needs of stock during seasons in which the feed directly available from permanent pastures is inadequate. Undoubtedly on some farms this alternative course is preferable. Indeed, one may go to the extent of saying that on some farms arable cropping, haymaking, and ensilage all may quite well be ruled out because of the particular circumstances.

Certain aspects of a well carried out all-grass programme, including ensilage and haymaking, are of considerable practical importance. Incidentally, but a very small proportion of farmers carry out well the all-grass programme even in the districts in which it probably would be of the greatest value. This apparently is due primarily to the fact that its practically general application in any farming community is not altogether easy under the present organization of farming. On this point an examination of the position in a particular district certainly suggests that the general adoption of an all-grass programme well carried out would necessitate some substantial changes in the position relative to farm labour, assuming the present supply of labour on farms is efficiently employed in the summer under current practice.

A summary of the Auckland position may be given thus · For its dairy needs alone Auckland, under an all-grass programme, should harvest at lease 1,000,000 acres of hay and silage annually. Against this is to be set the fact that the present areas of hay and silage harvested for all the needs of Auckland annually is about 250,000 acres, and in this connection it is to be noted that, in addition to one million dairy cows, Auckland supports about three-quarters of a million other cattle and two and three-quarter millions of sheep, to both of which some special feed might be fed with advantage. That Auckland should save 1,000,000 acres annually for dairying under an all-grass programme is based on the following considerations . Customarily about 52 per cent. of the whole year's production of permanent pasture occurs in the three months October, November, and December, whereas only about 30 per cent. of the feed-consumption in dairying takes place in the same period. Hence, to deal with the surplus feed, about half the total dairying acreage would need to be utilized for hay or silage during the same three months. The total dairying acreage is about 2,000,000 acres--there are a million cows for which provision has to be made, and it takes about 2 acres to support a cow. Possibly the utilization of labour-saving equipment and practices would to a large extent enable the area of hay and silage to be increased four-fold, but practical experience on this seems somewhat scant.

Apart from any possible difficulty in respect to labour, a matter of some moment is that silage and hay of the sort usually saved is not suitable for all purposes for which special crops are of value. For instance, silage ordinarily is too fibrous to serve effectively as an alternative to soft turnips and crops of somewhat similar nutritive character for dairy cows in summer. Likewise, silage is not suitable as an alternative to roots, peas, and cereal grains for use by pigs during periods when dairy by-products

and leafy pasture-growth are in short supply. Just whether silage of a less fibrous nature should be saved more generally seems as yet not to have been established.

Another matter deserving of some attention is that the adoption of the all-grass programme tends to eliminate the direct improvement of pastures by the traditional procedure of ploughing up poor swards, growing special forage crops, and eventual renewal of the pastures. The growing of special forage crops is not a necessary intermediate step between the breaking-up and the renewal of pastures ; indeed, at times it may be advantageous to omit it as an intermediate step. But, in general, some judicious forage cropping between the breaking-up of poor pastures and their replacement by good ones has been for many years, and is to-day, associated with much successful farming. Against this it may be stated that in the hands of some men and in some circumstances success has not attended forage cropping. But similarly in the hands of some farmers and in some circumstances success has not attended phosphatic top-dressing, a fact which certainly does not disprove the general advisability of phosphatic top-dressing.

From the preceding summary of the position the question that arises naturally is " How in practice can one distinguish between farms on which an all-grass programme is advisable and ones on which it is not advisable ? "

This question cannot be answered satisfactorily in a way which would give information always applicable on individual farms. Knowledge of the circumstances on the farm is necessary as the basis of a reliable answer relative to a specific farm. But some general guidance is provided in the following facts :--

In the first place, generally it will prove definitely advisable to use the plough and to grow special crops such as mangels, turnips, and cereals whenever substantial improvement of some of the pastures on the farm could be obtained by ploughing them down and eventually resowing a permanent pasture. The development during the last decade, under official seed-certification, of assured supplies of superior strains of plants important in permanent pastures has added to the number of farms on which the use of the plough is profitable as a step towards improved swards. Before assured supplies of persistent strains of such important pasture-plants as perennial rye-grass, cocksfoot, and clovers became obtainable there was always a danger of a new pasture not for long being superior to the poor one which it displaced. But this danger can now be avoided by the use of certified seed : inferior open pastures can, with practical certainty, be replaced quickly by good ones of reasonably long life by ploughing, sowing good strains of permanent plants, and suitably maintaining fertility by such measures as top-dressing. As a legacy in some measure from the time when assured supplies of persistent strains of the principal pasture-plants were not obtainable, there is still a tendency to repair pastures when ploughing should be the first step to their renewal. While it may be possible to repair a pasture by top-dressing, harrowing, and surface-sowing of seed, the quicker and more thorough result obtained by renewal often makes the renewal economically preferable.

It is also generally advisable to grow arable crops such as mangels, swedes, chou moellier, &c., when this can be done without any substantial direct outlay in equipment and labour. And this applies usually even to farms the pastures of which are not especially in need of renewal. In short, if cropping can be carried out without neglect of some of the necessary routine work of a farm and without necessitating the employment of much additional labour, then it is probable that cropping should be done.

Expansion in Ensilage advisable.

The fact that on many farms there is a strong case for expansion of special forage cropping does not justify the conclusion that ensilage already

is being carried out as much as is desirable. Actually there is wide scope for profitable expansion in ensilage, firstly by the adoption of ensilage by many of the considerable number of farmers who have not yet resorted to it, and secondly by the expansion of the area of ensilage on many farms on which it is carried out regularly. In many circumstances the most suitable farming programme is the one which gives a place to both special arable cropping and to ensilage, together with haymaking when the weather favours the making of good hay.

Special Long-term Crops.

The increasing attention being given to certain crops is worthy of mention. These crops under suitable conditions serve for many years as a direct supply of feed during periods when the feed directly available from pastures is scant. Lucerne for summer use and subterranean clover are outstanding examples. Such crops minimize the role of both special arable crops and ensilage, and it seems desirable that they play a much bigger part in the future than they have played so far.

Main Factors governing Yield of Arable Forage Crops.

One of the key factors in successful arable cropping is adequate cultivation; the best possible returns are not obtained from judicious expenditure in other matters such as seed and manure unless such expenditure is associated with cultivation thorough enough to give throughout the growing-season of the crop a good supply of moisture and air in the soil, together with conditions for the development of a good root system. The preparatory cultivation for forage crops is often markedly below the full possible requirements of the crop, and so a poor crop may be foretold even though liberal manuring and the use of the best seed is practised. When an arable crop follows old pasture a common and grave weakness is failure to break down the old turf enough to ensure not only free movement of soil moisture, but also free development of roots, both of which may be checked by the pockets of air often to be found below a buried turf which has not been well broken down. Skim-ploughing or disking of a turf before ploughing it down is at times of assistance in breaking it up sufficiently.

Another important factor in good yields is the use of good seed. Commonly a small saving in seed is correlated with poor germination or low vigour of seed or with poor type or strain of plants. There is evidence that some of the complete or partial failures, such as poor "strikes," which have been attributed to unfavourable weather, pests, &c., are due essentially to poor seed

A further factor, often of importance, is liberal manuring to give enough plant-food material to ensure that the supply of such material is not an unduly limiting factor in yield. The error of under-manuring is widespread: this may be realized from the fact that, while the value of 1 ton of even the least nutritious of forage crops is more than sufficient to pay for 1 cwt. of the fertilizer commonly used with them, it is but seldom that 1 cwt. of manure does not give an increase in yield of considerably more than 1 ton an acre.

The Mangel.

Good treatment of the mangel is particularly advisable—in the absence of a fine firm seed-bed such as is most easily obtainable by early and thorough cultivation, poor yields may readily result. Over wide areas, November sowing is suitable, and as wet or cold conditions tend to lead to loss or stunting of seedlings sowing should be deferred until warm soils may be expected. Standard practice is to sow about 6 lb of seed an acre in rows 26 in. to 28 in. apart. Based on its tonnage an acre, Prizewinner Yellow Globe is the most popular variety, but considerable areas of other varieties of known value such as Red Intermediate, Long Red, Golden

Tankard, and Jersey Queen are grown. While manurial requirements vary considerably according to soil and climate, field experience shows that good results may be expected over wide areas from a dressing of 5 cwt. to 6 cwt. an acre of a mixture consisting of equal parts of superphosphate and blood and bone or three parts of superphosphate to two parts of blood and bone. Kainit, which contains 14 per cent. of potash as well as a considerable amount of common salt, may be added when there is evidence that the mangel crop would benefit from potash.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Cultivation.

THE cultivation of the soil should continue to receive special attention. The ground should be worked down to a depth of from 3 in. to 4 in., so as to conserve the soil-moisture and to allow of the free access of air to the soil. To maintain the full benefit of cultivation, the formation of a crust when the land dries after rains should be prevented by stirring the soil immediately it is dry enough to work. Ploughing in the orchard at this time of the year is not recommended, as the deeper cultivation seriously disturbs and destroys many of the feeding roots: this causes a considerable reduction in the food-supply of the trees at a vital period of their life—that of fruit setting and stoning. In localities where spring ploughing has not been completed owing to the condition of the soil or to other circumstances, every endeavour should be made to have it completed as soon as possible, and preferably at a reduced depth.

Fertilizers.

Growers who intend to make an application of nitrogenous manure during the spring should do so during the present month.

Spraying.

Spraying for pests and diseases should be along the lines set out in these notes in the September *Journal*. The wet weather with hot days intervening, which has been recently experienced, was favourable for the development of fungi such as black spot and brown rot. Growers are urged to apply sprays thoroughly and to cover the whole surface of the tree including the fruit with a protective film of spray. It is just as important to spray the underside as it is the upper surface of the leaves and fruit.

Planting.

Trees planted during the spring which are growing now should be carefully examined and only three good shoots should be left; these shoots should be about 3 in. to 4 in. apart on the trunk of the young trees. No two or more shoots should be allowed to start from the same point, as if these are allowed to grow, then when the trees commence to carry a crop the branches are liable to split away from the trunk.

On two-year-old and older trees planted this season shoots likely to interfere with the proper development of the main or leader shoots should be suppressed.

Budding and Grafting.

If stocks on which buds have been worked have not already been cut back, this work should be attended to at once, so as to encourage a straight trunk, or branch. The cut should be slanting and slightly lower on the side opposite the base of the bud. In windy situations the shoots should be tied to and supported by stakes driven firmly into the ground to prevent them being broken off before they become properly established.

When grafting has not been completed this should be completed as early as possible, as the weather may soon become hot and dry, and under these conditions grafting may not be entirely successful. Grafts that have "taken" should be examined, and where necessary the ties should be loosened around the scions to prevent the material cutting into them as they swell. It is advisable to rewax the grafts where necessary. The shoots arising from the stock should be pinched back, except those arising from a suitable position for budding in the autumn should any of the grafts fail to take Later in the season, if not required, the latter should be pinched back. In exposed situations the scion-growths should be tied to protect them from damage by wind To do this a stake should be driven firmly into the ground beside each branch grafted, and then the growth should be tied to the stakes.

Thinning of Fruit.

One of the many questions that is exercising the minds of the leaders of the fruit industry is the matter of keeping inferior fruit off the markets. The most successful way of solving this problem is for growers not to grow inferior fruit. It should be the endeavour of every fruitgrower in the Dominion to produce better fruit. It should not be a question of how many fruit a tree can be made to produce, but the paramount aim of every grower should be "quality." As a rule trees set and mature two to four times as many fruit as they should be allowed to do, and if the crop is not thinned sufficiently according to the vigour of the tree there results a large percentage of inferior fruit, with a correspondingly small proportion of high-grade fruit. There is more money in an average crop of high-grade fruit than there is in a heavy crop of small inferior fruit Hence, why allow the trees to continue to produce fruit which is unsatisfactory to the grower, fruit-merchant, retailer, and consumer, when the position can be greatly improved by consistent thinning? If a grower has not thinned his crop already, then he should do so now, and he will be well repaid for the labour entailed. Thinning should be commenced in the early stage of the growth of fruit; if left until fruit is well grown the tree becomes exhausted and cannot produce the superior article that is required. Some growers prefer to do the thinning by hand, but the use of special thinning shears is recommended, as when thinning is done by the fingers the remaining fruit is often loosened, with the result that it soon falls.

The leaf-roller caterpillar, which does more harm in some districts than does codling moth, is more readily kept under control if single fruit only are allowed to remain.

—*B. G. Goodwin, Orchard Instructor, Christchurch.*

Citrus-culture.

During the spring and throughout the summer disease-control is an important part of the work in a citrus grove. The old slogan "prevention is better than cure" holds good, particularly in the case of fungous diseases. Spraying by the calendar is of very little value. Each grower must make careful observations of the stage of tree-growth, the hatching of insect pests, and of the first signs of disease in his own orchard. This task often can be carried out during picking operations. When the identity of any disease is doubtful, specimens should be forwarded to the local Orchard Instructor for identification. Particulars of the circumstances under which the specimens were found should also be supplied. It is necessary that the cost of production be reduced, and, while this cannot be accomplished by the omission or the curtailing of essential spray-applications, much extra expense is often incurred by the failure of orchardists to recognize the incipient stages of disease in their groves.

Verrucosis is a disease which, once it has become established in an orchard, is liable to spread rapidly if weather conditions are favourable

and control measures are lax. The main measure of control is to protect the young fruit from infection by a covering of Bordeaux 3–4–50 as soon as they have been formed. Although the blossoming of lemons is almost continuous, there is a distinct main flowering period which occurs (with most varieties) in the late spring. In ordinary circumstances, where verrucosis has been kept under control, the fruit-set application is all that is necessary. On the other hand, in cases where the disease has been prevalent, an additional application of Bordeaux at the pre-blossom stage serves to destroy any infection which arises from lesions on old fruit, leaves, and shoots. Where the trees have been worked on rough lemon (citronelle) stocks, a search should be made for suckers which have grown up from the roots—such suckers should be removed, as they are exceptionally susceptible to the disease. Citronelle stocks in a nearby nursery may also be a source of infection.

Melanose is a disease which attacks fruits, foliage, and shoots : infection takes place when these are young and tender. It is controlled by spraying at early fruit-set, and, where Bordeaux is applied for verrucosis control, further spraying is not necessary, but the cutting-out of dead and badly infected wood is advisable.

Bark-blotch becomes active in the spring, and the trees should be systematically and thoroughly examined for the tell-tale gumming and diseased bark which is typical. It is not enough to walk casually up and down the rows of trees. In old groves in particular it may be necessary for the person making the examination to get down on his hands and knees in order to make a close scrutiny of the bark of the trees, especially that near ground-level, where perhaps injuries made by hoe or cultivator have afforded a means of ingress to the disease. Bark-blotch can be more readily controlled if it is detected in the early stages while the infection is confined to small areas. If the disease is widely spread throughout the grove the small infections should be attended to first. When a tree becomes so badly diseased that it no longer produces a reasonable quantity of good fruit, it should be removed without further delay and replaced with a young tree. This practice is quite safe, provided that a large-sized hole is dug, and that this is filled up again with fresh soil. The method of treating the disease is to cut out the diseased bark, right down to the wood, and well into clean bark at the edges. These should be left smooth to facilitate the formation of callus. The wound should be swabbed with acidulated mercuric chloride, and then, when dry, painted over with a wound-dressing such as a bitumen emulsion.

Black Aphis.—Where the aphides are so numerous that they detrimentally affect the growth, particularly on young trees, spraying is advisable. Summer oil 1–80 or nicotine sulphate, 40 per cent., 1–800 plus soft soap 4 lb. to 100 gallons is effective, provided good contact is made with the pest. This necessitates careful work, directing the spray right into the clusters, which are often protected by curled-up leaves. *Aphelinus mali* parasitizes this aphis, and may be expected to minimize infection to a considerable extent.

Thrips.—The control of this pest is often overlooked, and the loss it has caused by the reduction of the grade of fruit through russet has not been fully realized. Experiments which have been carried out indicate that little control is obtained in the spring, probably because the blossoms afford excellent protection to the thrips, which are able to take cover well down between the pistils and stamens. After the fruit has set there is less cover for the insects, and they may be controlled either with lime sulphur (polysulphide content 15 per cent. at 1–40 to 1–80, or nicotine sulphate, 40 per cent., 1–800 plus soft soap 4 lb. to 100 gallons, or the two may be combined, in which case the soap should be omitted). Care should be taken to see that lime sulphur is not used at too close an interval to oil sprays, otherwise scorching may occur. A suitable time to apply this spray would

be three or four weeks after the Bordeaux applied at fruit-set period. Where the pest is very prevalent, the nicotine sulphate should be included in the Bordeaux spray as an additional check. A good pressure and thorough work is very desirable.

In connection with the use of Bordeaux mixture, it is now standard practice to add a summer oil at a dilution of 1 per cent. This improves the wetting and spreading properties of the spray.

Reworking.—Unfortunately, just as with other kinds of orchards, many citrus groves contain a number of trees which have to be worked over for some reason or other, such as variety unsuitable to the locality, unpopularity of fruit on the market, poor bearing strain, or perhaps the production of rough off-type fruit.

Although grafting may be practised, the method almost universally used for citrus trees is budding. Grafting, particularly when the stock wood is heavy, necessitates very careful work, and very often there is a weakness owing to the large wounds, which take years to heal over, during which time there is a danger of the entry of borer or fungous disease. Small trees or light wood on older ones may be grafted by the whip or rind graft. Citrus trees should be grafted in the late spring, when they are in active growth.

Budding.—Except during the winter, when there is little or no growth and the bark does not lift freely, citrus trees may be budded almost at any time. The two main periods for this work are spring and autumn. Spring budding may now be proceeded with. Any approved method may be used such as the inverted "L" or "T" or even the erect "L" or "T." The buds should be obtained from trees which are known to be producing heavy crops of fruit of good quality. Care should be exercised in selecting the type of bud-wood, and sticks which are round should be taken in preference to angular ones, and they should be of good normal growth of about the diameter of an ordinary lead-pencil. If the trees to be worked over are young, there is no difficulty in locating suitable wood for budding. In small-branched trees it is best to insert a bud into each of the limbs, fairly close to the trunk. By inserting a number of buds one ensures that the failure of one or two buds does not cause any delay in starting off the new variety. The reworking of old trees is a more difficult task. Here again it is advisable to work on the younger wood as much as possible It is desirable that the process of changing to the new variety should extend over a period of two or three years. By this procedure the balance of roots over top is well preserved, and the young growth from the buds is less liable to be flooded by an excess of sap.

General.—Cultivation and cleaning round the trees should be continued. Particular attention should be paid to any newly planted trees to see that they do not become loose, as root damage may develop in loose trees and a soil pocket may be formed round the trunk, and this may hold rain-water if the soil is retentive. Picking should be kept up to date.

—*A. R. Grainger, Orchard Instructor, Tauranga.*

POULTRY-KEEPING.

The Breeding-pens.

At the close of the breeding-season many poultry-farmers are faced with the breaking-up of their breeding-pens and the disposing of all surplus cock birds. Before doing this, it is well to consider the advisability of retaining one or two of the very best for special matings during next season. Where flock mating has been practised and the leader of the pen is observed to be an outstanding bird, it would be advisable to hold him until at least there has been time to test out his pullets.

Every season some very valuable birds, which should have been retained for further use, are sold for a few pence. This point is mentioned as on several occasions plants have been visited where an extra fine lot of pullets has been raised, and on asking to be shown the sire of these pullets the Instructor has been told that it is a practice each year to sell all cock birds as soon as the hatching season is over, as cockerels are more satisfactory for early breeding.

While it is economical and a good plan to get rid, as soon as possible, of all cocks that show any sign of not being of any further use, it is, however, well to remember that a prepotent male, one that leaves stock of extra high quality, is a very valuable asset on any farm, and such birds should be retained for special mating for as long as they will produce that quality of stock so much desired. Birds possessing the characteristics indicated are rare and are not easy to breed, and so every care should be taken to make the very best use of them.

Toe-picking amongst Chickens.

Each rearing-season information is sought in reference to the cause of and remedy for that annoying cannibalistic habit of chickens toe-picking one another. As the causes may be varied it is very difficult to advise poultry-keepers without examining the stock and knowing something of the conditions under which the chickens are being reared. Indications at times tend to show that this is a deficiency trouble, perhaps in some cases the result of faulty incubation, or the breeding from pullets or hens that were forced for egg-production and were somewhat exhausted and consequently not in the best condition to produce eggs which in turn would produce perfect chickens. Contributing causes may be overheating of the blood by feeding a deficient diet, or even too much bright light under the hovers. At the first signs of the trouble the chicken that has been attacked should be separated from the rest and the affected parts should be painted with creasote or iodine. Plenty of straw chaff should be provided in the brooder-house, so that the chickens may bury their toes in it. Finely-cut succulent green food should be given three times a day, and a trial should be made of giving the last lot after the last feed of broken grain at night. The addition of milk and a little more animal food to the ration should help matters. If this trouble gets really bad it is well to darken the brooder-house for a few days in order to prevent the sun from shining in on the toes of the chickens, as the trouble is often started by pecking at one another's toe-nails.

Green Food.

As nothing does more to keep birds in good healthy producing-condition than a regular supply of a variety of succulent green food, it is well to make provision for a good supply now that the weather is getting warmer. No poultry-keeper ever regrets giving his young growing stock as much succulent green food as they will eat.

A patch of silver-beet is very useful. Stock of all ages are very fond of this green food, and, owing to its freedom from insect pests and disease and the enormous amount of succulent green leaves and stems which it produces, silver-beet is one of the most popular green-food plants. This plant may be sown in the spring or in the autumn, and it stands transplanting well. Green oats and barley make fine green food, when chaffed, and may be regularly grown during most of the year.

Chou moellier is another plant that supplies a great amount of attractive green food, and could with advantage be more widely grown by poultry-keepers, especially where winter green food is difficult to get. Where a stand of lucerne can be established it proves a valuable asset, and, where insect pests are not troublesome, kale and rape make a very pleasant change.

When rearing chickens in the natural way with hens, if they have not access to young grass they should be regularly supplied with tender green food.

Stale Ground.

As stale ground is responsible for a great deal of the unthriftiness amongst young stock, it is well to see, if at all possible, that all young stock are reared on fresh sweet ground. If birds are reared on stale ground their growth is usually checked and they seldom develop well, with the result that when they come into profit their eggs are usually small. It is well to encourage young stock to roost early. Leghorns and other light breeds should be ready to perch at about seven weeks old, and the heavy breeds a couple of weeks later.

As Leghorn cockerels are usually very precocious, it is advisable to separate the sexes as soon as possible, as both cockerels and pullets grow better when reared separately.

Growing stock should never be stinted ; though a four-months-old cockerel eats as much as an adult bird, it should be given all it will eat. If separated from the pullets and given plenty of good plain food, all surplus cockerels should be ready for the market at from four and a half to five months old. This is the best age to sell cockerels, for as they get older they usually lose condition and are really of less value as table birds.

A well-primed four-and-a-half-months-old cockerel usually brings a higher price on the open market than one eight months old, as the latter is what is known to the poulterer as a " stag." When it is desired to produce prime cockerels it is advisable to confine them in small clean pens so that they do not get too much exercise. Their food should consist of mash three times a day, as much as they will eat A mixture of one measure of bran, three of pollard, and one of maize-meal, with from 5 per cent. to 7 per cent. of meat-meal added, the lot being mixed to a fairly crumbly condition with skim-milk, will give good results Plenty of green food and, where available, milk can be given to drink as well as water.

Great care should be taken to avoid the crowding of poultry, especially young growing birds, for more culls are made this way than any other. If one finds that more young stock have been hatched than what there is accommodation for, it is much wiser to get rid of the extra birds as soon as possible and give the remainder every chance to develop into profitable stock than to try and hold on to the lot and thus overcrowd.

The Water-supply.

A test carried out at this Department's Wallaceville Poultry Station showed that forty hens drank 3 quarts of water during one day in June, whilst the same birds consumed 6 quarts 1 pint during one day in July, and 6 quarts 3 ounces during one day in August. The test also showed that when hens are laying they drink over twice the quantity of water that they do when they are not producing. When with these facts it is remembered that one dozen of new-laid eggs contains almost 1 lb of water, and that the flesh of fowls and their eggs contain from 60 per cent. to 70 per cent. of water, the great importance of a good water-supply must be recognized. At times there is a tendency by some poultry-keepers to overlook the great importance of this very necessary item of successful poultry management. As nothing reduces egg-production more quickly than leaving hens short of water, it is not only cruel but most uneconomical to deprive hens of a regular supply of clean water. If young growing stock are left short of water they fail to develop properly. Most large poultry-farmers have spent much time and money in designing a suitable watering-system for their birds, and many have arranged gas-taps so that there is a constant drip of water into the drinking vessels. A good watering-system is shown in this Department's Bulletin No. 66, " Utility Poultry-keeping," copies of which may be obtained from the publisher, Department of Agriculture, Wellington, at a cost of 1s. each, postage free.

Whatever system is adopted, care should be taken to see that all birds have a plentiful supply, and as disease is often transmitted from one bird to another by means of the drinking-water, it is essential to see that water vessels are kept in a clean and sanitary state.

Chick-sexing Examination.

Chick-sexing examinations were conducted by the Department at the Wallaceville Poultry Station and at Christchurch at the end of August. In all, eight students undertook the examination, and two were successful. Mr. J. C. Jamieson, who sexed 100 chickens in eighteen minutes with an accuracy of 91 per cent., qualified for a second-class certificate Mr. D. E. Hopkins, who holds a second-class certificate and who sexed 50 chickens in nine minutes and a quarter with an accuracy of 96 per cent., qualified to have his certificate endorsed.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Seasonal Preparations.

OCTOBER is perhaps the month when the apiarist can do most in helping his bees to work up to full strength in time for the main honey-flow. In the warmer parts of the country swarms may be looked for about the middle of the month, but in the southern districts they probably do not appear until three or four weeks later. By 1st October, unless the weather for some weeks has been cold and wet, every hive should have been examined and its condition noted with regard to stores, population, and health.

No colony should be allowed to dwindle because it has not sufficient food to provide for the offspring of a prolific queen. On the other hand, some beekeepers prefer that all the old honey in the hive should be used up before the new season's flow commences. The food-supply of the hive is sometimes an exceedingly puzzling matter, as it varies considerably in accordance with the weather and the strength of the colony, and only periodical and systematic examinations can settle the question as to whether all is well with the hives in this respect. No harm can be done by feeding good white-sugar syrup, but a hive which is starved in the spring probably does not recover its strength till the main honey-flow is nearly over. By the middle of October, under normal weather conditions, every hive should have at least four frames of sealed brood, and many have more. Those that have fewer, unless their food-supply is very short, should be marked for requeening as soon as possible. The apiarist's endeavour should be to keep his colonies as even as possible, thereby obtaining a uniform surplus throughout the apiary.

Wherever there is a fair yield of nectar from spring flowers the beekeeper would do well to take advantage of the warm days of the month to treat any cases of disease which he may have noted earlier in the spring. However, no hard-and-fast rule can be laid down in this matter, as everything depends on locality and weather conditions. In some districts it would be almost suicidal for the beekeeper to treat his bees in October; in others, where right conditions prevail, it may be carried out with ease and safety, and the bees brought into good condition by the time a surplus may be expected. Wherever treatment has been undertaken, the colonies should be watched in order to see that there is no danger of starvation, and where the spring flow is not considered heavy enough it should be supplemented by liberal feeding.

Hiving Swarms.

In most text-books on beekeeping this kind of advice is given : " When a swarm settles into a cluster take a light box and shake the bees into it," &c. This advice is of use where the bees are accommodating enough to settle into a convenient position for the shaking process to be carried out. Unfortunately, in many cases bees get into positions whence it is impossible to dislodge them quite easily. Sometimes they settle on a small bush, and much of the cluster is on the ground. In this case probably the best thing to do is to place the box over the cluster, and if the bees do not show much disposition to climb up into the box they may be persuaded to do so by the use of a little smoke. When they cluster in the centre of a prickly hedge the box should be placed on one side of the hedge, and the beekeeper should puff smoke from the other side of the hedge, and thereby drive the bees towards the box. In the event of the swarm taking possession of a fencing-post and clustering on it from top to bottom, as they occasionally do, the smoker must again be used, and, in addition, it is as well to brush the bees from each side of the post in turn into the swarm-box with the brush which is used for the frames at extracting-time.

The usual practice is to leave the box sheltered from the sun and covered with a sack near the place where the swarm has settled. Where few hives are kept this may be done with impunity, but if other swarms are expected it is well to remove the box to the place where the colony is to stand permanently, otherwise before the close of the day the probabilities are very largely in favour of the box being taken possession of by three or four other swarms—a matter of annoyance to the man who wishes to keep his swarms separate.

In every case a swarm should be attended to as soon as it settles Many people are under the impression that swarms should be left undisturbed till nightfall, but this idea is an erroneous one They should invariably be placed in the box as soon as possible after the cluster is formed, and put so that they are sheltered from the rays of the sun.

Water-supply.

One of the most important of the minor details of apiculture is the provision of a constant water-supply for the purpose of assisting the bees in brood-rearing. Not only is it necessary to conserve the energy of the bees by having the water close at hand, but it is well to ensure that they do not prove a nuisance at taps, cattle-troughs, &c. From early spring till late autumn water is an absolute necessity to bees, and they consume comparatively immense quantities in fine weather. It thus behoves the beekeeper to see that a liberal supply is always available By establishing his drinking-fountain early in the season he teaches the bees where to go for supplies, and ensures their always seeking the same spot for water.

---*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

In seedling crops sown outside thinning and weeding are now among the most important operations ; neglect at this stage is a common cause of poor crops. Where the land is properly prepared and seeds are sown thinly, weeding and thinning need not be very tedious. By ploughing, harrowing, and cultivating sufficiently early to allow weed-seeds near the surface to sprout and be destroyed before the crop is sown, what may be called a clean start is obtained. Under the best conditions, however, some weed-seeds sprout with the crop in about a fortnight, and, on the first fine day when the land is sufficiently dry, they should be destroyed by hoeing,

thus disposing of them easily before they grow past their seed-leaves. This attention must by no means be omitted, but should be repeated as required until the crop spreads sufficiently to check weed-growth. Thinning takes a great deal of time, patience, and care, but is much reduced by studying the seeds and knowing their nature and condition, especially germinating-capacity, and sowing them at the most suitable rate. Incidentally seed sown at a suitable rate generally sow an area twice the size of that sown at ordinary rates. Whichever way is adopted the seedlings must be suitably spaced to produce good plants. These are not such as cause wonder at their great size; good plants of this description are usually of moderate size, as they are better for the table, and probably yield as heavily per acre as larger specimens if the thinning is not excessive.

In the cooler districts where half-hardy vegetable crops, as tomatoes, &c., are grown, they are planted out during the first week in November, or as soon after as weather permits. On light land, especially where it is inclined to be dry, clean summer cabbage, or other green vegetable of that class, is difficult to grow unless silver-beet is sown in early spring, or New Zealand spinach (*Tetragonia expansa*) is planted out now about 2 ft. or 3 ft. apart in the row. The latter is a vegetable of high repute overseas and should be more extensively grown in this its native country, where it is commonly found growing wild on light land near the coast. It is a wholesome vegetable which cooks to a good colour, and is even more palatable than most vegetables of its class. Furthermore, it is little troubled with pests and diseases.

Celery is in good demand, and should be planted out so soon as the plants are available. In dry localities it is planted in trenches to facilitate watering; elsewhere it may be planted out on flat land. For the early summer crop—and the late crop also in the warmer districts—the self-blanching varieties are most suitable. A good crisp variety of lettuce may be sown now to mature without transplanting. This seed usually germinates freely, and for growing in this way should be sown very thinly. In cool districts the garden swede turnip is sown during the month of November. Where it is desirable to grow this vegetable in warmer localities, it is best to defer sowing until the month of January.

In the unheated glasshouse the tomato crop commences to ripen during the month of November. Under the crowded planting conditions liquid fertilizers should be given to finish the crop well, so that the greater part of it is marketed before the end of January when the outside crop begins to ripen. In the absence of local experience the following mixture may be tried and modified as it is found desirable: 1 oz. superphosphate and ½ oz. each of sulphate of potash and nitrate of soda, in liquid form, per square yard. On light land inclined to dry out it is usually an advantage to mulch with strawy stable manure which assists in retaining moisture as well as feeding the crop to some extent. In preparation for this application the exhausted leaves at the base of the plants are trimmed off, taken out of the house and destroyed. On bright days when the temperature rises above 65° F. all the air possible should be given. The high temperatures frequently found in the houses during summer are detrimental to this crop.

Small and Sundry Fruit Crops.

The small-fruit harvest now commences with the culinary gooseberries; and one kind or the other is available to the consumer during the months of November–December, with the season straggling into the following months. These berry crops ripening in summer between the long seasons for tree fruits are most popular for all of the purposes to which culinary and dessert fruit may be applied. Some of them are perishable, but with an improvement in the system of distribution the public would doubtless gladly take greatly increased quantities. The fruitgrower who neglects the study of the marketing side of the business misses many of the profits.

The successful grower is usually one who rather specializes on this phase of the industry. With small fruits good packing and prompt despatch the same day as the fruit is picked are important points. Clean picking avoids the production of over-ripe fruit which so often stains an otherwise good pack and gives a bad impression when opened up by the consignee. In long-distance shipments especially this fault should be carefully avoided.

Strawberry-beds are mulched as soon as the crop commences to set. This is specially important where the soil is inclined to be light, and gritty particles of soil are splashed on to the berries during rain unless the mulch is laid. Baled straw is most suitable for this purpose, but rushes and pine-needles are often used with good results.

Many varieties of red currants now make vigorous growths, which are often blown out by strong winds. By "stopping" them before this happens the growths are hardened up, become more fruitful, and loss is avoided.

The Homestead Garden.

The early part of the month of November is usually the best time for planting out half-hardy annual flowering-plants In some gardens where a gay appearance during the summer season is desired this is often an important feature which demands experience, taste, and a good deal of consideration to carry out in the best style It is probably most popular and effective in towns where the residents have a comparatively restricted outlook. Country gardens, however, may often be made more attractive and a little diversity introduced by planting out a bed or comparatively large group of stocks, asters, zinnias, &c., in a well-chosen spot. Where a good supply of humus is present some bonedust and a little "complete" manure worked in bring the plants away quickly and ensure a good display.

In some situations climbing-plants may be allowed to ramble, but under most conditions the display is more effective if the plants are trained by controlling the growth and tying it in over as wide a space as is desirable. Control is obtained generally by stopping new growth which is not required by pinching out the tip after a few leaves have developed, and tying in that which is needed. Periodical attention of this description during the summer months gives superior results very quickly. Wistaria, bignonia, bougainvillea, &c., are attractive plants which are at their best when trained in this way It should be remembered that young plants of this kind planted at the foot of a wall usually suffer from a lack of moisture until they have made considerable growth and the roots have spread out into the moister soil. Liberal watering and a surface mulch during the summer months therefore are of great assistance in the early stages.

When the half-hardy annuals have been disposed of it is customary to sow herbaceous perennial flowering-plants for autumn planting and biennials for a display during the winter and spring Many spring-flowering perennials may be increased by division, soon after flowering ceases

Many inquiries are received regarding the composition and extent of plantations, hedges, and shrubberies for various purposes Usually these can be specified with the best results only after carefully studying the locality and giving consideration to the object in view. Hurried decisions are the cause of endless disappointments in this regard. Those who have the management of land, whether the area be large or small, should closely study the growth of plants of this kind in their locality. Trees and shrubs for timber, shelter, fruit, or ornament are among the important crops grown on a farm, and should receive the consideration given to others. In fact, owing to their more permanent character and dependence on local conditions, they require much more consideration if they are to be grown with any real measure of success. Failure in the past has been due not so much to management as to the selection and arrangement in the first place.

The summer season is most suitable for thoroughly studying the behaviour of trees and shrubs under one's local conditions, especially in local public and private plantations and gardens, also the nurseries. The owners usually have much information about the plants which have been grown, and generally find pleasure in discussing them with any one who is really interested, as an exchange of experience is of mutual value and advantage. It is important to obtain the correct name of a plant under consideration and write up the information obtained so that it may not be lost. By restricting the scope of the study and inquiry to features of immediate interest the labour need not be great, and one is ready to give practical application to the information obtained when the planting-season arrives, either by extending the plantations or modifying those already established.

—*W. C. Hyde, Horticulturist, Wellington.*

REVIEW.

Flour-milling Processes, by J. H. SCOTT. 416 pp. Chapman and Hall, Ltd.

IN flour-milling research has added in recent years knowledge which begets development, and this book meets the need of those desiring to keep up to date in their knowledge of the flour-milling processes The book is based largely upon the considerable personal experience of the author, but, when advisable, the observations and results of other authorities are cited. The author indicates that he considers that finality has not yet been reached in flour-milling, but aims to present a relatively complete picture of our current knowledge. In this he has achieved such success that the book contains information of real value to both theoretical students of flour-milling and to practical flour-millers.

Evidence of the trend towards improved farming continues to be provided in the maintenance of a relatively heavy, and in several instances an increasing, use of certified seed In the 1936 harvest there were record acreages devoted to the production of certified seed of potatoes, wheat, white clover, cocksfoot, and Italian rye-grass, while the perennial rye-grass acreage increased in comparison with that of the previous harvest The major portion of the certified seed produced is used by the farmers of the Dominion, and from the superior characters inherent in certified seed its use makes possible increased production of crops and pastures —*Annual Report, Director-General of Agriculture*

WEATHER RECORDS: SEPTEMBER, 1936.

Dominion Meteorological Office.

NOTES FOR SEPTEMBER.

SPRING characteristics were very strongly developed in the weather for September. Pressure was almost continually low in the south, and there was consequently a persistence of westerly winds, which were frequently strong and squally. The weather changed rapidly and there were few days on which western and southern districts failed to experience a certain amount of rain. East of the ranges conditions were finer and more sunny. Until the 19th, temperatures were generally low, and although the last ten days were milder, they did not quite make up for the earlier cold. The wet and cold weather retarded growth of vegetation in western and southern districts of the South Island and over most of the North Island, where frosts were rather numerous. In Hawke's Bay, about Wellington, in Nelson, and the Marlborough Sounds, there was rapid growth, and the season is well advanced. There is no shortness of feed for stock anywhere, though in some places feed is rather soft. Stock are reported to be in good condition, and the lambing-season, in spite of some losses due to cold and strong wind, appears to be progressing satisfactorily. In eastern districts of the North Island a good warm rain would be beneficial, while in western districts and the high country generally a spell of dry, sunny weather is desired.

Rainfall. Though there were no very heavy general falls, rain was frequent throughout the month in all districts with a westerly aspect, and most of Otago and Southland. In eastern districts from Canterbury northwards and also in the Bay of Plenty area and Nelson the totals were generally below average. Elsewhere they were above, the month being very wet in western Otago and Southland.

Temperatures.—Temperatures were everywhere below normal, though the departures were not large. In western districts they were generally about 1°·5 F. but elsewhere seldom as much as 1° F.

Sunshine.—The persistent westerly weather caused a lack of sunshine on the west coast of the South Island and in Southland, while, according to the New Plymouth record, Taranaki recorded about the average amount. Elsewhere totals were above average, and eastern districts experienced a very sunny month. Blenheim had 225·6 hours and Napier 210·6.

Pressure Systems.—The sequences of pressure changes experienced throughout the month were remarkably constant in character and typical of spring. The anticyclones all passed well to the north of New Zealand and a series of westerly depressions, each followed by several secondaries, moved rapidly from the west across the South Island. Winds blew almost continuously from some westerly quarter, and gales were frequent in some part or other of the Dominion. During the first few days cold south-westerlies prevailed. Conditions were especially boisterous on the 3rd to the 4th, when there were widespread falls of snow in both Islands.

There was some variation in the type of weather from the 21st to the 25th. An intense anticyclone was centred near Chatham Islands from the 22nd to the 24th. This brought northerly winds and warmer weather over New Zealand. A shallow cyclone developed just to the north-west of the Dominion and moved in an east-south-easterly direction across the Bay of Plenty. By the 26th, however, the westerly type of weather was again fully restored.

Thunder and hailstorms were rather numerous during the month, especially in western districts, and a tornado occurred near Tauranga on the 10th. In addition to that mentioned in reference to the 3rd and 4th, snow fell on the high country on the 6th, 18th, and 26th and 27th. At the end of the month the ranges were well coated.

RAINFALLS FOR SEPTEMBER, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average September Fall.	Total Rainfall to Date.	Average Rainfall to Date.
North Island.						
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	3·58	15	1·12	4·90	44·47	43·66
Russell	4·57	13	2·15	3·89	76·49	41·19
Whangarei	4·68	20	0·99	4·85	54·12	49·95
Auckland	3·69	19	1·43	4·05	42·57	38·52
Hamilton	4·36	18	1·39	4·32	41·79	37·43
Rotorua	3·63	9	1·54	4·07	51·13	41·83
Kawhia	4·17	17	1·20	4·57	45·76	40·75
New Plymouth ..	6·32	25	1·11	4·92	47·77	45·33
Riversdale, Inglewood ..	8·29	25	1·05	9·56	75·92	77·16
Whangamomona ..	6·67	17	1·10	7·11	56·39	56·10
Hawera	4·58	15	1·02	3·42	36·45	33·53
Tairua	3·09	17	1·30	4·92	42·26	50·63
Tauranga	3·11	18	1·20	4·29	45·53	40·41
Maraehako Station, Opotiki	4·80	15	1·26	4·21	54·63	41·94
Gisborne	1·21	11	0·29	2·99	35·95	37·28
Taupo	3·63	13	1·28	3·82	39·69	33·12
Napier	1·67	8	1·10	1·93	40·50	24·23
Hastings	1·23	10	0·62	2·63	35·08	26·05
Whakarara Station ..	2·20	13	0·28	..	44·36	..
Taihape	4·07	19	0·82	3·04	35·77	26·56
Masterton	1·81	13	0·52	3·00	38·08	29·54
Patea	4·79	22	0·83	3·59	39·03	33·03
Wanganui	2·99	8	1·00	2·87	32·03	26·72
Foxton	2·76	14	0·58	2·40	32·07	23·73
Wellington	2·44	16	0·77	3·20	42·95	32·87
South Island						
Westport	8·68	22	1·00	8·30	60·80	70·80
Greymouth	8·22	24	1·40	8·09	66·29	73·06
Hokitika	11·25	23	2·90	9·02	75·24	82·31
Ross..	16·99	25	4·37	12·43	90·32	94·81
Arthur's Pass ..	9·56	17	2·13	15·29	87·83	111·36
Okuru, South Westland	16·31	16	2·05	11·89	110·44	105·69
Collingwood	6·25	20	1·31	9·31	71·44	71·76
Nelson	3·37	12	0·73	3·58	31·54	28·44
Spring Creek, Blenheim	2·27	11	0·80	2·59	28·30	23·23
Seddon	1·71	9	0·52	2·14	22·70	18·76
Hanmer Springs ..	3·82	14	1·00	4·43	43·12	33·91
Highfield, Waiau ..	1·62	8	0·57	2·99	29·91	25·52
Gore Bay	1·28	7	0·44	2·94	28·42	24·25
Christchurch	2·07	11	0·75	1·93	27·66	18·92
Timaru	0·96	7	0·36	1·90	22·93	16·33
Lambrook Station, Fairlie	1·34	8	0·51	2·18	20·58	18·31
Benmore Station, Clearburn	2·02	11	0·80	1·93	18·05	17·95
Oamaru	0·74	6	0·28	1·64	19·53	16·08
Queenstown	3·96	18	0·97	2·54	26·89	21·97
Clyde	1·12	10	0·38	1·05	10·39	10·50
Dunedin	2·90	19	0·61	2·75	34·35	26·88
Wendon	3·65	16	0·72	2·42	23·16	21·69
Balclutha	2·86	16	0·50	1·89	26·18	18·16
Invercargill	5·19	24	0·55	3·24	35·37	33·02
Puysegur Point ..	19·17	28	2·55	6·36	76·63	61·71
Half-moon Bay ..	10·14	25	1·39	5·02	42·88	42·94

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PASPALUM AS A PASTURE-GRASS.

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Paspalum dilatatum is a sub-tropical grass. It thrives best in warm districts with a high rainfall. The main growth is made during the heat of the summer. The plant is of strong growth, deep-rooting, and perennial. Individual plants spread laterally to a considerable distance by the development and growth of short underground rhizomes. In this way plants established a foot or more apart can in a year or two cover the ground with a dense sward. The leaves are long and broad. They are produced at first from the numerous crowns of the plant and later appear at regular intervals along the flowering-stalks. The plant in the leafy stage is very palatable and nutritious. Even when flowering it continues to produce palatable leaves. When kept closely grazed or mown the crowns produce a succession of leaves ideal for grazing stock Paspalum can grow in the shade and can thus invade and supplant clumps of rushes and tall fescue and other swamp growth It smothers out blackberry and bracken fern if assisted in the early stages. It can survive fairly long periods of flooding and inundation On loose soils the roots penetrate for many feet in search of moisture. On soils with a stiff subsoil or hard pan it is often affected by dry weather and tends to become root-bound It has, however, often penetrated shallow pans and stiff soils, and, if well provided with plant-food, thrives when other pasture-plants are dried up. It cannot withstand severe winters where the ground is frozen, but otherwise it is not killed by fairly severe frosts. The colder the winter the slower it is to come away in the spring. Paspalum is rapidly becoming more and more acclimatized to frosts, and in many districts in the Auckland Province it is not now cut back by frosts of seven degrees and more.

EARLY CONFLICTING VIEWS REGARDING VALUE OF PASPALUM.

From 1900 to 1920 or even later the merits and disadvantages of paspalum as a pasture-grass in the Auckland Province were discussed wherever farmers met. While some farmers acclaimed its virtues as a wonderful summer-feed producer on swamp land too wet in winter or too dry in summer to grow rye-grass and cocksfoot, others would have none of it. The latter drained and cleared and ploughed and cropped and sowed to English grasses. While some

on hill land planted and sowed paspalum, and in the early stages at least had green summer pastures, others pointed to the lack of growth in the winter and were satisfied with dry summer pastures, and later stressed the tendency to root-binding. Even the enthusiasts began to doubt the wisdom of the extensive spread of paspalum when its colonizing ability by seeding began to be realized. This was particularly so in North Auckland, where from the free seeding of hill-sown paspalum the better land in the valleys and flats was invaded. Through inability to stock the summer growth adequately the paspalum became rank. It crowded out all other species. When frosted growth or the dry harsh growth of summer had to be eaten in the winter indigestion and compaction in stock caused serious losses. In time, on the poorer hill land, paspalum became root-bound and unproductive. This was because it was starved. The difficulty of cultivating and cropping land once it was invaded by paspalum was also held against the grass. Despite these disadvantages enthusiasts continued to sow and introduce paspalum throughout the warmer northern and coastal parts of the Auckland Province, and as far south as Hawke's Bay and Taranaki. It found special favour in grassing, with little effort on the part of the farmer, river-flats and swamp land partially covered in logs, stumps, blackberry, rushes, and tall fescue, &c. Others, by not sowing and by rigorously grubbing out odd plants brought in by stock, endeavoured to keep it out.

Paspalum is a great colonizer where climatic conditions favour it, and particularly where for one reason or another other pasture species do not thrive. Gradually it has invaded the better class of hill country and the river-flats and swamp lands throughout the northern peninsula and coastal areas where the frosts are not too severe. It has also, through being sown or by colonizing, occupied considerable areas of the poorer hill land where, on account of fairly rapid root-binding and starvation of the paspalum, danthonia and brown-top would produce more feed. Fortunately danthonia is able to dominate paspalum on much of the drier hill country, and brown-top combines well with it on the moister slopes. Paspalum as a pasture-grass has limitations and disadvantages, but the fact remains that the introduction and spread of paspalum in North Auckland and the warmer parts of the Auckland Province generally has seen a tremendous increase in the production from dairying, sheep-farming, and cattle-raising. It can be claimed that the advantages have far outweighed the disadvantages.

Importance of Management.

The difficulties of control, management, and utilization of paspalum pastures have forced on farmers the development of management methods which have brought out more prominently the many excellent qualities of the grass. Faults attributed to paspalum, such as the smothering effect on other species, the shortage of winter and spring feed, the coarseness of the feed in late summer and autumn, root-binding and falling-off in production, have in recent years been more and more recognized as really faults in management. In the early stages, owing to the roughness of the land surface, the prevalence

of logs, stumps, &c., and the size of paddocks, the rank summer growth could not be controlled. Other species were smothered out, the pastures became pure paspalum, and the winter carrying-capacity was far too low to allow for efficient stocking in the summer.

Farther south, where the establishment of pure paspalum swards for summer-feed production was advocated, paspalum has not made much progress. The low feed-production for six or more months of the year of such pastures far outweighed the advantage of good summer-feed production, particularly in districts where the summer was generally fairly well provided for.

The outstanding feature in connection with the better management and utilization of paspalum is the realization on the part of the farmer that practically all the other pasture species he would like to have in his pastures can be established and maintained with paspalum. Further, the management necessary to do this is exactly what is required to get the most from the paspalum as a summer-feed producer.

PASPALUM WITH PERENNIAL RYE-GRASS AND WHITE CLOVER.

Perennial rye-grass and white clover on land capable of supporting these species, either sown in the original mixture with paspalum or introduced later by surface-sowing, have been maintained indefinitely. The growth period of the perennial rye-grass is much earlier than that of the paspalum. The rye-grass grows in the winter and early spring, and as it dries off the paspalum takes up the running. The white clover combines well with the paspalum, growing over and amongst the crowns and providing the paspalum with much-needed nitrogen. This combination can be achieved and maintained only under fertile conditions, and provided always that the paspalum is not allowed either by stocking or mowing to grow rank and coarse season after season. When well managed, this is an excellent pasture, with a long production-period.

Because in northern districts the paspalum comes away early, cocksfoot is apt to find the competition too severe, but farther south cocksfoot and paspalum can be grown to advantage in the same field, the cocksfoot coming away earlier than the paspalum and growing on later into the winter. Where the perennial rye-grass and white clover cannot grow on account of flooding, or because of inability to mow or graze efficiently on swamp land, *Lotus major* combines well with the paspalum, but every effort should be made to provide conditions suitable to rye-grass and white clover.

With top-dressing, controlled grazing, and the use of the mower, many thousands of acres of dairying-land are now growing what is the ideal combination, perennial rye-grass in the winter and spring, so strong that no paspalum is to be seen, and, as the rye-grass goes off, white clover and paspalum throughout the rest of the year. There are still many more thousands of acres where this type of pasture should be the aim.

Paspalum with Subterranean Clover, etc.

Where the fertility is not up to the rye-grass standard subterranean clover, which commences growth in the autumn and continues until the early summer, makes an excellent companion to paspalum, providing well for the period of low feed-production by the paspalum. On hill country brown-top and crested dogstail, *Lotus major* and *L. hispidus*, also combine well with paspalum, providing again that the paspalum is controlled.

A feature of the development of the idea of using paspalum as one of the species in a mixed pasture has been the use in recent years of true perennial strains of perennial rye-grass and white clover. The introduction of these strains to paspalum swards by ploughing, and more recently with the development of suitable implements by surface cultivation, is being successfully practised. Conversely, the establishment of paspalum in rye-grass and clover pastures by surface-sowing in the late spring or feeding out paspalum hay has also been extensively practised on farms which have hitherto kept paspalum out.

A more general recognition of the fact that paspalum can be controlled, that other useful species can combine with it, and that all-the-year-round pastures can be obtained by the use of paspalum together with other species is likely to extend the range of usefulness of paspalum far beyond its present limits.

Treatment of Root-bound Paspalum.

One of the most difficult problems in connection with the management of paspalum is the condition known as root-binding. Where paspalum has become root-bound there is a decided falling-off in production. This condition is now recognized as being due to starvation. Although the root-bound paspalum is producing very little feed, it is safe to say that no other grass, with perhaps the exception of danthonia, would produce more under the circumstances. The renovation of such root-bound paspalum swards wherever practicable can be achieved by ploughing in narrow lands, cultivation, and the sowing of other species: perennial rye-grass and white clover, subterranean clover and brown-top, or the lotus species are suitable according to the future policy with regard to top-dressing. The cultivation renews the vitality of the paspalum and provides plant-food for the growth of other species for a time at least. Considerable areas of root-bound paspalum have also been successfully renovated by the use of special cultivating-harrows and rye-grass and white clover introduced. The success of this method and the future production of the pasture depends on whether top-dressing is practised to a very large extent. Continued top-dressing after renovation prevents a recurrence of root-bound paspalum, which is very slow in responding to manuring. The tearing-open of the matted surface roots allows the grass to make use of the fertilizer much more quickly and effectively. Paspalum stands all the cultivation that can be given it, and frequent and regular cultivation with the disks or penetrating harrows is one of the main methods of keeping it thriving and preventing root-binding.

Top-dressing and winter stocking with heavy cattle will also prevent this condition. On steep hill-country where root-binding tends to be a bad feature closing paddocks for a summer or two and stocking heavily with grown cattle when the ground is wet has been adopted with satisfactory results.

CONTROL OF PASPALUM BY MOWING.

The controlling of the paspalum, particularly by the use of the mower, has demonstrated more clearly the wonderful summer butterfat-producing capacity of paspalum itself.

The rank summer growth of paspalum, besides smothering out other species, is unpalatable and innutritious as autumn and winter feed. Wherever the mower can be used surplus summer growth should be put away as hay and silage. Paspalum hay is often described as being coarse and unpalatable Difficulty is often experienced in making silage from paspalum. The coarse rank material, mainly flowering-stems, does not pack well, and the silage over-heats. These are not faults of the grass but of the farmer. Paspalum for either hay or silage should be cut before it comes into flower. For silage-making early cutting to get a mixture of other grasses and clovers with the paspalum, well before the latter comes into flower, is strongly advocated.

On good land a second and even a third cut of leafy paspalum that will make excellent hay or silage can often be secured.

In stacking leafy paspalum hay it will be found that a very high centre must be kept in the stack, and provision made for topping-off the stack. as the material tends to settle rapidly after stacking It is far better practice to take two leafy crops than one heavy coarse crop of inferior feeding-value. On pure paspalum pastures the early growth is often too long to get a crop. By running the mower over a paddock intended for hay, prior to closing, the growth can be made to come away much more evenly.

ARABLE CROPPING OF AREAS IN PASPALUM.

The impression is still prevalent that when once paspalum is established cultivation and cropping is out of the question. Old root-bound and neglected paspalum swards are admittedly difficult to plough and cultivate. The indifferent cultivation one often sees under such conditions serves only to stimulate the growth of paspalum, but it is not sufficient for a satisfactory crop even without the competition of the rejuvenated paspalum. Sufficiently early and thorough cultivation to prepare a satisfactory seed-bed for the crop also serves to keep the paspalum in check until the crop is grown.

Where paspalum has been kept in good order, ploughing and cultivation are not nearly so difficult, and satisfactory crops can be grown. The paspalum, which tends always to re-establish from seed and pieces of root, can be dealt with in the same way as other deep-rooting weeds. Up to 100 tons per acre of mangels and 80 to 90 bushels of maize have been grown on paspalum paddocks broken up for cropping When seeded to grass again it is not necessary to resow the paspalum, since even after several years of cropping there is enough seed in the soil to give a good take of paspalum.

Sowing Paspalum.

Paspalum-seed germinates best in hot, moist weather; for this reason November and early December sowing was frequently advocated. Since paspalum should be established with companion species which are better sown in the autumn, the best practice is to include paspalum iu the mixture and sow in the autumn. Paspalum can be established quickly as a pure seeding if sown with millet or maize or even soft turnips in the early summer. When sown with other species in the autumn it is slow to establish. By sowing before the end of February or early in March a much better strike and quicker establishment of all species is obtained, and this early sowing specially favours paspalum. Seeds of paspalum will lie over the winter and germinate the following summer. When once scattered plants are established the thickening-up of the paspalum can be hastened to a great extent by letting the plants run to seed in the summer. On account of the dense sward, paspalum is difficult to establish with brown-top. From 4 lb. to 5 lb. of seed is sufficient in a mixture on ploughed land and 2 lb. to 3 lb. on burns.

Paspalum-seed.

The best seed is imported from Australia, where the seed crop ripens more evenly than it does here, and seed-harvesting methods are generally better. About 1920 the average germination of Australian seed coming to New Zealand was about 40 per cent. Samples of local seed ranged in germination from 0 per cent. to 20 per cent. or 25 per cent. At present local samples are being obtained ranging from 20 per cent. to as high as 50 per cent. At the same time, however, Australian samples up to 70 per cent. have been on the market. The necessity for buying and selling paspalum-seed on a germination basis should be apparent. The main difficulty with local seed, which is preferable on account of the acclimatization of the plants, is the uneven ripening, the loss occasioned by unfavourable harvesting weather, and the varied harvesting methods Tests have shown that the germination of the pure paspalum-seed in local samples is practically as good as that of imported seed. In local seed, however, the amount of empty seed-covers and immature seed is often as high as 60 per cent. to 70 per cent., whereas in the best imported seed rubbish is reduced to 20 per cent. to 30 per cent.

Conclusion.

Though considerable progress has been made in recent years in the management and utilization of paspalum as a pasture-grass, much yet remains to be done before a considerable proportion of our farmers are taking full advantage of its possibilities as a wonderful summer-feed producer. The conserving of surplus summer growth when still palatable and nutritious, the combination of paspalum with other species with a different growing-period, and the maintenance of fertility to prevent starvation of the paspalum are the lines along which further progress with this grass will be made.

VINE-CULTURE UNDER GLASS.

(Concluded.)

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DISEASES, DISORDERS, AND PESTS OF THE VINE.

OIDIUM OR POWDERY MILDEW (UNCINULA NECATOR).

Powdery mildew appears in the form of greyish patches of mould on leaves and young shoots. When it is neglected the whole surface of the leaves may become covered with the mould. On the berries it at first appears as a white powder, somewhat like lime, but when much developed it becomes like a grey felt and completely envelops the berries. While it is one of the most destructive vine-diseases when not subject to effective control, it is not feared by expert growers. Probably there are no crops which are entirely free from mildew, but where the vines are under skilled management infection is of a trifling character and easily controlled. The frequent cases in which crops are ruined by this disease are entirely due to mismanagement.

Attacks are most likely to occur during the early period of growth, when leaves, shoots, and fruit are all young and tender. If the attack is severe, and is not checked, it will persist during the whole season. Autumn attacks are also common, occurring in houses which have been free from the disease till that time.

A humid, stagnant atmosphere with a temperature above 58° F. is favourable to the development of Oidium. Fresh air is essential to the control of this disease, but draughts must be excluded or Oidium is almost sure to make its appearance.

As a preventive of the annual recurrence of Oidium, dry sulphur should be applied early in the season to the vines, and particularly to the breaking buds, where the fungus hibernates; and some should be scattered along the top and bottom plates and over the floor of the vinery. The fumes or emanations which arise from the sulphur at a temperature of 80° F. and over destroy the fungus. The shoots should be dusted again when 4 in. to 6 in. long, and again when the flowers open. Applications can be made later at fortnightly intervals, if considered necessary.

Under dry conditions, when vines are syringed with water to assist the buds in breaking, sulphur can be applied with the water daily until the shoots are 3 in. or 4 in. long, after which dry sulphur can be used. To mix the sulphur, dissolve 1½ oz. soap in 4 gallons of water; then with a little of the water added to 1 lb. of sulphur make a paste and add to it the remainder of the water, gradually mixing the whole thoroughly.

As dry sulphur is liable to cause irritation in the eyes, rubbing them should be avoided, and when dusting is completed all sulphur should be carefully removed from the face, and the eyes, if affected, bathed in a weak solution of bicarbonate of soda, borax, or a little sweet milk.

A solution of potassium sulphide or liver of sulphur dissolved at the rate of 1 oz. to 3 gallons of water, and, alternatively, lime sulphur at the rate of ½ pint in 4 gallons of water, are both good controls, and do not affect the eyes, but both disfigure the white lead paint with which vineries are generally painted (it is claimed that zinc paint is not affected by sulphur sprays).

These liquid sprays are applied at the same periods of growth as the dry sulphur, with the exception of the flowering period, when dry sulphur only should be used.

Where the fungus is already in evidence it can be killed by spraying with hot water (160° to 170° F.) during the hottest part of the day (11 a.m. to 3 p.m.). By mixing 2 parts of boiling water and 1 part of cold water, this temperature can be obtained approximately. Dusting the vines with dry flowers of sulphur should follow after sunset. Finely divided sulphur gives the best results, and is most easily and effectively applied with a sulphur bellows or a dust-gun.

The fungus can also be destroyed by a solution of Condy's crystals (permanganate of potash) made with sufficient water—to which ½ oz. of slaked lime per gallon has been added—to reduce the colour to a light pink. This spray is very effective, but care should be taken in applying it, as it marks the paint. It does not act as a preventive, and should also be followed by sulphur.

GREY ROT (BOTRYTIS CINEREA).

On the leaves and grapes grey rot shows as a grey mould and later changes to a mouse-coloured, fluffy mould. It causes ripe grapes to shrivel to dark purple-coloured mummies, which remain attached to the stems. The disease cannot occur except in a very damp and stagnant atmosphere. Where it occurs the conditions of the house should be altered by proper ventilation, and all affected grapes cut out. The mould form of the disease can be checked by spraying with liver of sulphur at the rate of ½ oz. to a gallon of water. All dead leaves and prunings should be collected and burned and the house thoroughly cleaned. These precautions should be taken even in the case of vines not affected by disease.

EXCORIOSIS (PHOMA FLACCIDA).

Excoriosis attacks the laterals of the vine mainly at the base between the internodes, where either greyish patches covered with small black points or dark brown patches—or both—form. Later the bark cracks, and the wood is disintegrated so that the laterals frequently fall off. These laterals and their fruit should be burnt with all the affected parts of the vine, which are liable to perpetuate the disease. At pruning-time affected laterals should be cut back to the base bud as usual, and the whole vine swabbed a little later with a solution of 30 per cent. of sulphate of iron reinforced with 1 per cent. to 2 per cent. of sulphuric acid. Quantities for 4 gallons of the solution are—12 lb. of sulphate of iron, ½ pint of sulphuric acid, and 4 gallons of water. The sulphuric acid is poured on to the sulphate of iron and the water then added. A wooden vessel painted inside and out with paraffin-wax or tar makes a suitable container. As the mixture is corrosive it should be kept off the hands, clothes, and boots.

Later, when the young shoots are about 3 in. long, spray with a 4-per-cent. solution of sulphate of copper to which enough washing-soda has been added to turn a red litmus paper blue, covering more especially the base of the shoot from where the foliage has been taken off. Follow with three or four sprayings of the same strength at intervals of a fortnight. The sulphate of copper-washing-soda solution is known as Burgundy mixture, which is prepared as follows (the quantities given are for 4 gallons of the mixture) : Dissolve 1 lb. 10 oz. of sulphate of copper in 2 gallons of water and approximately 13 oz. of washing-soda in 1 gallon of water. Then pour the soda solution into the copper solution, stirring vigorously, and complete to 4 gallons by adding sufficient water.

RIPE-ROT.

Ripe-rot is caused by the fungus *Glomerella cingulata.* It first appears on ripe grapes as brown spots, which increase in size, rupture the cuticle, and cause a rot. Once a berry is attacked there is no remedy, and affected berries should be cut off. It is not practicable to spray ripe grapes, therefore the only remedy is to increase the ventilation and prevent as far as possible an accumulation of moisture during the night. This involves keeping late growths from crowding the trellis.

SHANKING.

Sometimes the footstalks of the berries and even the stems of the bunches wither through lack of nourishment ; they are then said to have shanked. Shanked berries fail to colour or ripen properly, and are sour and uneatable. Different opinions are held as to the cause of shanking, but all agree that it is a root trouble, and that it is induced by the roots being in sour soil. Sour soil need not necessarily be wet soil, though excessive wetness will cause shanking, and should be remedied by attention to drainage. Roots growing down into cold subsoil may be the cause, and they should then be encouraged to remain nearer the surface. Cases are recorded where shanking has been extensive for a number of years, but had since been avoided by the simple means just indicated.

SCALDING.

Scalding occurs both on leaves and on berries, and in some cases is extensive and causes serious losses. This disorder, like shanking, is usually spoken of as a disease, but this is not correct, as no pathogen has been found in either case. Scalding, or scorching, may be due to the direct action of the sun or to variations in temperature. When it occurs on leaves it is in nearly all cases due to the action of the rays of the sun upon foliage ; it may develop at any time during the day. If foliage is allowed to crowd against the glass the free passage of air is checked, and the leaves remain wet till dried by the heat of the sun—scalding is sure to take place in such circumstances. To a lesser extent leaves may be burned by the focussing of the sun's rays through faults in the glass. The common glass used is full of such faults, and it is rare that some amount of burning does not occur from this fault, but never to a harmful extent. Berries exposed to the direct

rays of the sun may also be scorched, this generally occurring near or during the ripening-period. Scorching involving considerable damage has also taken place when the vine-leaves were very thin. Leaves which are of a flimsy texture are unable to withstand the heat of the sun, and burning results. Such poor condition of the foliage is due to a want of plant-food, and can be remedied by supplying what the vines need. Another cause of this condition is dryness at the roots and an arid atmosphere, resulting in semi-starvation, with consequent feeble leafage, which is bound to scorch. It would perhaps be better to speak of this result as "scorching," which it really is, rather than as "scalding"; it is not the trouble usually meant by authorities when speaking of scalding.

Scalding proper occurs during the stoning-period, and sometimes causes very serious losses. It has been stated previously that the stoning-period is a critical time. The berries, during the three or four weeks of stoning, make practically no increase in size and are very susceptible to injury, so that any attempt to force them into growth is likely to result in damage being done. Scalding in this case is not due to direct sunlight for berries that the sun cannot reach are scalded. It is due to a too-wide range between day and night temperature, combined with atmospheric moisture Damping-down should therefore be reduced to a minimum and a little top-air should be left on all night, except during bad weather. More air should be given very early in the morning to dispel moisture, and, above all, to prevent a sudden rise in temperature. The greatest danger is a sudden rise of temperature in the morning.

THUMB-MARK.

Thumb-mark is a physiological trouble believed to be due to sudden changes of temperature, and generally appears after bright sunshine following dull cold weather. Depressions ("thumb-marks") appear on the surface of the grapes, which gradually turn brown and wither. Affected berries should be cut out. There is no cure. Grapes are liable to be affected from after the stoning-period until they begin to change colour.

WARTED LEAVES.

A common trouble known as "warted leaves" occurs mostly in the warmer districts. The leaves have a rough surface, covered with warts or intumescences. The leaves affected are usually of a gross character, indicating that the roots are functioning in rich soil. Such leaves are heavily charged with water, and are very susceptible to injury. The damage usually is caused by a current of cold air admitted before the foliage has dried.

AERIAL ROOTS.

It is not uncommon to see vines with bunches of aerial roots hanging down from each spur. The cause may be a warm and moist atmosphere combined with lack of proper ventilation. In most cases, however, it is due to faulty root-action, the roots having grown into cold soil. This again may be due to poor drainage. In any case it is not a desirable state, and should, if possible, be put right.

MEALY BUGS.

Mealy bugs are insects which are aptly described by the name applied to them: the term "mealy bug" serves to distinguish them from any other grape-vine pest. The rapidity with which the insects propagate, and their habit of depositing their eggs under the bark, beneath the scales of buds, and in crevices in the building, particularly the rafter, make them the most difficult of all insects to get rid of. It is practicable to free small vineries of mealy bugs, but in the case of large houses it is impracticable to devote the time needed to carry out the treatment that proves effective in small houses.

In small vineries scrubbing the rods with hot water has been found by many growers to be effective. It is necessary first to remove loose bark, then to scrub the rods with a fairly stiff brush, using water at a temperature of about 130° F., which is hot enough to kill the bugs but does not injure the buds. In bad cases the rods should be scrubbed twice—at the time of pruning and again a few weeks later. Before the buds begin to move the rods should be dressed with a solution of lime sulphur, 1 in 10, applied with a paint brush. All prunings and leaves should be carefully collected and burned, and everything needful done to thoroughly clean the house, so as to get rid of bugs that have fallen to the ground. The rods must, of course, be taken down for cleaning; before tying them up again thoroughly and forcibly spray the whole interior, avoiding the rods, with a solution of kerosene emulsion at a strength of 1 in 12.

To control mealy bug when the grapes are green, spray with ½ oz. of nicotine sulphate, 40 per cent., added to four gallons of water in which sufficient soap (about 1 oz.) has been added to make it frothy.

This spray, whilst destroying some of the bugs, acts principally as a deterrent, and may be used about every fortnight until the grapes are partly coloured, when hydrocyanic gas can be employed. Spraying with hot water at 130° F. is also a good control which kills both bugs and eggs without damaging the foliage or fruit.

Where a good pressure of cold water can be obtained the mealy bugs can be flushed off the vines on to the wet floor, where they generally die. The water may be applied at midday in warm weather, and followed up the next day with the nicotine spray.

Cyanide Fumigation: The Pot Method.

In large houses fumigating with hydrocyanic-acid gas appears to be the only way to get rid of the pest. This gas is of a deadly nature, and human life is endangered by any carelessness. It is therefore best to avoid its use where other methods can be made effective. A good deal of care in its use is necessary while the vines are in growth, as it readily injures tender foliage, either of the vine or of other plants in the house, and may also injure the berries. In theory, damage from its use can be avoided, but it proves to be difficult in practice. Cyaniding should not be attempted before the berries are partly coloured, when 2½ oz. is effective and safer than 3 oz. per 1,000 cubic feet. It is noticed

that authorities in England now advise its use only after the grapes have been cut, and no doubt this is the wisest course. As fumigation does not kill the eggs, a second treatment should be given after an interval of about a fortnight.

Fumigation should be done after sunset on a calm day, when the heat from the sun has declined; the temperature should not be above 60° F. or 70° F. if the grapes are still hanging. The house should be made air-tight, and the vines and buildings should be as dry as possible. After treatment the house may be kept closed all night, but must be opened before sunrise on the following morning. When opening the doors care must be taken not to inhale the air of the house, and the house should not be entered until at least one hour after the doors have been opened.

For every 1,000 cubic feet of space in the house use 3 oz. avoirdupois of sodium cyanide (or, if not obtainable, 4 oz. of potassium cyanide), 4 fluid oz. of commercial sulphuric acid, and 12 oz. of water. Provide an earthenware basin for every 10 ft. of length in the house, the basin to be of a size proportionate to the amount of chemicals it will be required to hold. The necessary quantities of cyanide should first be weighed out and wrapped loosely in pieces of tissue paper, which should then be placed near the basins. If the cyanide is in large lumps these must be broken until they are not larger than a filbert nut. The water should first be placed in all the basins, and then the sulphuric acid added. The cyanide in the paper should be added last of all, beginning at the basin farthest from the open door and working quickly towards it, as the gas spreads rapidly. The paper will delay the action of the acids for a moment or two. When sulphuric acid is added to the water heat is generated, and it is important that the cyanide be added before this heat declines; if it has cooled down the generation of gas will be slower and less in volume. A good grade of sulphuric acid should be used; lower grades may contain nitric acid, which would cause burning.

After preparing the cyanide it is advisable to wash the hands carefully, and the remaining cyanide, including the smallest crumbs of it, should be stored safely. The extremely dangerous nature of the cyanide and hydrocyanic acid for both animals and man should be kept in mind when operating. To obviate the risk of any person entering the house the doors should be securely fastened. Suitable measures should also be taken to prevent any one entering the open doors while the gas is being liberated.

Fumigating with Calcium Cyanide.

The application of calcium cyanide as a means of controlling mealy bug in vineries is as efficacious when used in a gas-tight house and is a more simple and less dangerous method than the pot method of cyaniding. Reasonable precaution should, however, be taken as the gas similarly causes death when inhaled. There is a risk of burning the foliage and grapes when they are young and tender. It sometimes happens that the mealy bugs are very much in evidence while the grapes are still green. Under these circumstances growers can afford to take some risks to obtain a clean and profitable crop.

The exact quantities which will exterminate the mealy bug without danger to the crop can be ascertained for each house by the grower himself by working up gradually to a dose sufficiently strong to kill the insects without burning the tender foliage of grapes. The necessary quantities, which should be duly recorded for future reference, will be found to differ considerably on account of the variation in the gas-tightness of the houses, which should be rendered as tight as possible.

In the tender stage of vegetation $\frac{1}{3}$ oz. per 1,000 cubic feet might be tried to start from, and when the grapes are beginning to colour —a much safer period—$\frac{3}{4}$ oz. When the grapes have been picked 4 oz. per 1,000 cubic feet can be tried. These amounts will probably have to be increased, as many vineries are far from gas-tight, and 8 oz. per 1,000 cubic feet have been found necessary in some cases.

In every case a second fumigation after a period of about twelve days is necessary to kill the young mealy bugs which may hatch out after the first application, as the gas does not sterilize the eggs.

To obtain maximum results fumigation should be commenced one hour after sunset, and the houses opened up in the morning before the sun strikes the vinery. Strong light, combined with cyanide gas, causes burning of the foliage. The foliage must be dry, as moisture absorbs the gas and the dilute acid causes burning. The soil of the vinery should be only slightly damp, and no standing water left in the house, as this would absorb the gas and weaken the dose. If the soil in the vinery is dry it can be watered not later that twenty-four hours before fumigation. The most favourable temperature at which to fumigate lies between 55° F. and 70° F. A calm night is an essential condition for success ; strong winds are apt to increase the leakage of gas.

To fumigate, place the required quantity of calcium cyanide in a wide-mouthed jar, or, in the case of a long house, in several closed jars or tins placed at intervals, and, walking from the closed end of the vinery to the door, scatter the contents evenly over the soil. Then close and lock the door and place a warning notice on it. As the gas is given off slowly from the calcium cyanide, there is ample time to scatter the chemical, without danger, at an ordinary walking pace. The gas will generally have disappeared by the following morning, but it is an advisable precaution to give the vinery an airing before entering.

To calculate the amount of calcium cyanide required, measure the body or lower part of the vinery, which may be 80 ft. long, 25 ft. wide, and 4 ft. high ; then, 80 ft. × 25 ft. × 4 ft. = 8,000 cubic feet. Now measure the upper or roof part of the vinery, taking a vertical line to the apex from a line drawn from top-plate to top-plate, say, 8 ft., of which take half and multiply the square of the body by that half—80 ft. × 25 ft. × 4 ft., which equals another 8,000 cubic feet. Then 8,000 added to 8,000 equals 16,000 cubic feet, the cubic content of the vinery. In a lean-to vinery the same method is applicable by measuring on the wall side from the level of the top-plate on the other side.

RED SPIDER (TETRANYCHUS TELARIUS).

This is a minute brick-red insect that attacks the leaves. If present in great numbers the vines are debilitated, because of the insects sucking the sap from the leaves. It is troublesome only where hot, dry conditions prevail, and in most parts of New Zealand need not be a source of trouble. The way of avoiding attacks is to supply sufficient moisture to the roots, and to prevent arid conditions in the house by damping down and syringing. The warmer parts of the Dominion are most favourable to the pest, and the very conditions that favour the spider make it possible to use more water in the house. Lime sulphur, containing 15 per cent. of polysulphide, 1 in 150, sprayed on to the vines before closing the house in the evening is a good control.

THRIPS.

The thrip is a tiny cigar-shaped insect, dark in colour when mature. It, like the red spider, is a sucking insect, but is more destructive than that pest. Like the red spider, thrips thrive in dry conditions, and treatment that will prevent attacks by spider is usually effective for thrips. If an attack occurs spray with nicotine sulphate, 40 per cent., 1 part by volume in 800 parts of soapy water—1 oz. of soap to the gallon. On account of its disagreeable flavour this spray should be used at least a fortnight before the grapes are eaten.

A thorough cleaning of the vines and house on the lines previously indicated for the control of the mealy bug is essential to the riddance of both thrips and red spider.

OBSERVATIONS RELATIVE TO PASTURE SEED-MIXTURES.

E. BRUCE LEVY, Grasslands Division, Plant Research Bureau.

THE ultimate structure in vegetation is determined by dominance, and dominance is based on the ability of the individual to respond to its environment. No two plants are exactly alike in their demands: each plant has its special growing-place. The indigenous forests in general carry a single dominant that largely determines the physiognomic features of the formation—the tawa or rimu, or white pine, or kauri, or totara, or southern beech. In forest development we recognize succession, and dominants appear to mark each phase in the succession: thus we have the manuka dominance, bracken fern, the indigenous induced hard fern, piripiri dominance, wineberry, mahoe, five-finger dominance, progressing to rewarewa, hinau, or kamahi dominance. In the tussock grasslands we see the same rise to dominance according to growing-place—the fescue tussock, the poa tussock, the danthonia tussock; and in the depleted lands of the South Island we see the scabweed dominant under the influence of the rabbit. In the artificial grasslands of New Zealand the trend to dominance is well observed—the rye-grass, cocksfoot, brown-top,

Danthonia pilosa, *D. semiannularis*, ratstail, paspalum, tall fescue, prairie-grass, floating sweetgrass, and *Poa aquatica* dominance respectively.

Dominance within a mixed association presupposes competition and ultimate survival of one plant over another. Survival is based on the ability to persist longer and to grow better than another plant under the conditions of the habitat, and the plant that is gaining ground and canopy in the association is rising to dominance, and, further, the plant rising to dominance is producing more growth than any of its competitors can or will unless there comes about a modification in the habitat. The real problem of the grassland farmer to-day and of the future is to learn just how to secure dominance of those pasture species that have proved themselves capable of high productivity when subject to conditions appertaining within a utilization plan whereby stock is the main defoliating-agent. He can also employ dominant swards where the mower is the harvesting-implement, and lucerne stands out pre-eminently in this respect. Lucerne is one of the few permanent agricultural crops where dominance is recognized as essential for the plant's own well-being.

The trend to simplification of pasture swards is the recognition among grassland workers and ecologists the world over--and it is fitting to mention the name of Professor R G. Stapledon, of Aberystwyth, in this respect--of the laws governing plant-life and plant communities.

Complexity in the pasture sward or in any plant association is in general a sign of non-aggression by any particular plant member, and when no one member of an association is aggressive there is probability of a weak, moribund community. There is ample evidence that the less thrifty and the more open the grassland association the greater the numerical strength of the species, and conversely the more thrifty and dense the association the fewer species that association contains Pasture-making is largely a question of harmonizing plant and environment, and the problem is to provide the environment that the high potential producer demands, and the more closely plant-demand and environment harmonize the simpler the association becomes and the simpler can the seed-mixture be that is employed.

Accurate knowledge is essential for the success of the simple seed-mixture: safety and latitude is afforded in the more complex seed-mixtures, but waste of seed must of necessity result, and care must be taken that an actual reduction in yield does not come about as a result of using the complex seed-mixture.

The claim for complex seed-mixtures is sound, however, where we are dealing with a complexity of soil types and a complexity of ecological conditions such as exist on bush-burn country—the fertile flats and hollows, the steep faces and exposed knolls, the shady and the sunny aspects. These cannot be uniformly grassed, and many seed-merchants have been libelled in regard to the seed-mixture provided for bush-burns or sowers reprimanded for uneven distribution of the seed. The irregular stand secured is but the reflex of one or more species in the seed-mixture becoming dominant according to aspect, and thus giving the impression that the sowing or mixing of the original seed-mixture supplied was at fault. In general also in sowing down to permanent pastures phases in the succession to an ultimate dominant should be provided for.

For the ploughable country where one can govern the habitat and management at will, the case is strong for the simple seed-mixture composed of one or two grasses and one or two clovers. The intimate mixture of grass and of clover is imperative, and no effort should be spared to get the best possible strains and to secure the best possible conditions for the establishment of these. It is of great practical significance that the grasses and the clovers are ecologically related, and no mixture-maker can afford to ignore this fact.

Control of the environment is presumed before simplification of seed-mixtures can be carried far. Soil-fertility and the correct soil-moisture, together with regulation of light and shade by means of pasture-utilization, are three master factors. The perennial rye-grass - white-clover mixture demands control of all three. The cocksfoot - red-clover - white-clover mixture demands an intensification of the shade factor, which means laxer utilization. This also applies in the case of such pasture-plants as timothy, prairie-grass, *Phalaris tuberosa*, and, to some extent, paspalum. The danthonia-clover - dominant sward demands an intensification of the light factor, and utilization by close grazing is a prerequisite. The brown-top - Chewing's-fescue mixture (as for lawns) demands control of the fertility factor if a correct balance is to be secured between these two species. This consideration on behalf of each species calls for niceties in management which can be given to a maximum degree only if the species of similar demands are grouped in simple mixtures by themselves and specially managed so that the correct environment for their maximum development is provided, and this necessitates special-purpose pastures of simple seed-mixtures, separately fenced in order that the correct management may be given to each. Already the claim of lucerne in this respect is recognized.

EXPERIMENTAL EVIDENCE RELATIVE TO SIMPLIFICATION OF SEED-MIXTURES.

Evidence to support the simple seed-mixture and the futility of wasting seed in complicated seed-mixtures where we are able to give reasonable manurial and management conditions to the grasslands laid down is contained in the following trials :—

TRIALS AT MARTON EXPERIMENTAL AREA.

Three years ago six seed-mixtures were laid down at Marton. They were exceedingly well managed under a system of mowing and grazing introduced there by Mr. A. W. Hudson, and were systematically manured. The results are tabulated in Table I.

From Table I it will be noted that under the conditions of the trial which favoured the rye-grass - white-clover sward it proved detrimental to add certain additional species to the simple basic seed-mixture, and this is definitely the case in regard to Plot 6, where the addition of *Poa trivialis* has detracted from the total three years' yield by approximately 4 per cent.

At Marton there was laid down at the same time as the seed-mixture trial given in Table I a series of cocksfoot - white-clover - red-clover plots to test out the significance of strain in cocksfoot and red clover. The

three years' yields of these plots are comparable to those in Table I, but the management has been more lenient, although probably not quite lenient enough for cocksfoot to produce its best.

Table I.—Showing Tabulated Results of Seed-mixture Trial at Marton after Three Years down

Seed-mixture sown. (Quantities in Pounds per Acre.)		Total Dry Matter of Mixture (in Pounds).	Relative Yields.	Species: Contribution per Cent. at 8th July, 1936.
(1) Perennial rye-grass ..	.. 30	33,139	100·1	82·9
White clover ..	.. 3			12·5
(2) Perennial rye-grass ..	.. 30	33,103	100·0	72·2
White clover ..	.. 3			22·5
Cocksfoot ..	.. 10			2·7
(3) Perennial rye-grass ..	.. 30	32,738	98·9	80·7
White clover ..	.. 3			11·1
Cocksfoot ..	.. 10			5·0
Italian rye-grass ..	.. 6			..
(4) Perennial rye-grass ..	.. 30	32,784	99·0	81·8
White clover ..	.. 3			11·1
Cocksfoot ..	.. 10			2·3
Crested dogstail ..	.. 3			Trace.
(5) Perennial rye-grass ..	.. 30	32,663	98·7	74·7
White clover ..	.. 3			17·4
Cocksfoot ..	.. 10			3·3
Timothy ..	.. 4			1·4
(6) Perennial rye-grass ..	.. 30	31,804	96·1	67·3
White clover ..	.. 3			4·9
Cocksfoot ..	.. 10			1·5
Poa trivialis ..	.. 4			25·7

The results are shown in Table II :—

Table II.—Showing Results of Seed-mixture Trials at Marton after Three Years down

(Trials sown 23rd March, 1933.)

Data from Trial.	Seed-mixtures. Rye-grass-White-clover.	Seed-mixtures. Cocksfoot-White-clover.	Seed-mixtures. Cocksfoot-Red-clover-White-clover.
Total dry matter (in pounds)	33,139	(1) 30,438 (Akaroa) (2) 30,310 (Aberystwyth) (3) 27,841 (Danish) (4) 30,512 (selection)	(1) 30,403 (Montgomery) (2) 30,225 (Broad). .. ..
Percentage botanical composition	Rye. 83 White. 13	Cocksfoot. White. (1) 51 37 (2) 50 39 (3) 40 52 (4) 55 33	Cocksfoot. White. Red. (1) 50 35 5 (2) 53 34 2 .. ..
Relative total yields	100	(1) 91·8 .. (2) 91·5 .. (3) 84·0 .. (4) 92·1 ..	(1) 91·7 (2) 91·2 .. ..

The utilization in the above trial (Table II) may have been over intense for cocksfoot to develop its maximum production, and it appears that this is certainly true of red clover, the addition of red clover making comparatively litt'e difference in the yield other than to depress it slightly. However, in the case of the cocksfoot it must be said that if the growth were allowed to get much taller the quality of the herbage would probably have deteriorated.

In these trials at Marton it would appear as if the yield can actually be depressed by the addition of species that are in themselves not as productive as the dominants in the mixture. In other words, species for a while at least may occupy ground that would better be occupied by the dominants, no consideration, of course, being given to any value that may be attributed to additional species from a dietetic point of view.

TRIALS AT MASSEY AGRICULTURAL COLLEGE.

In the autumn of 1934 a series of seed-mixture plots was laid down at Massey Agricultural College under—(1) dairy-farm management and (2) under sheep management. Point-analyses to arrive at ground-cover and dissection-analyses to arrive at actual botanical composition of the feed available to stock were made on these plots in May, 1936. The mixtures sown out and results to date are contained in Table III.

It will be observed that the addition of species to the general base has made little or no difference to botanical composition, and it would appear to date as though the cocksfoot and Montgomery red clover would not have been greatly missed had these been left out also.

The white clover used in the base mixture was certified permanent-pasture type, and it would appear that strain in the dominant species is likely to alter the botanical composition more than do any additional species. In this respect it is interesting to note the difference in the white-clover strains in respect to ground-cover and actual production as determined in the month of May. The higher actual productivity of the certified "mother" strain and the pedigree strain is determined by the cut and dissected analysis as against the certified perennial pasture strain is noteworthy, and in this respect Kentish wild white clover compares very unfavourably. In this strain in May the ground-cover is high but the yield is low.

Table III.—Botanical Composition of Fields derived from Pasture Mixtures sown down Autumn, 1934, and utilized since under Good Dairy-farm Management.
(Botanically analysed May, 1936. A = Ground-cover analysis; B = Cut and dissected analysis.)

Plot.	Base Mixture.										Species added to Base Mixture and their Contribution.			
	Italian Rye-grass (5 lb.).		Perennial Rye-grass (25 lb.).		Cocksfoot (10 lb.).		White Clover (3 lb.).		Montgomery Red (3 lb.).					
	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.		Lb.	A.	B.
1 ..	..	..	46	64	6	7	45	20	2	1	Base only ..	..	..	..
2 ..	..	..	43	71	9	7	39	18	1	3	No Italian ..	..	..	..
3 ..	..	..	53	71	7	7	35	17	..	1	Dogstail ..	3	2	..
4 ..	..	..	49	69	5	12	32	10	3	Tr.	Timothy ..	4	5	7
5 ..	..	..	57	77	3	7	38	14	1	..	Meadow fescue	12	..	..
6 ..	..	..	47	54	4	7	..	..	..	1	Mother white clover	3	43	34
7 ..	..	..	40	86	8	5	..	..	1	..	Kent wild white clover	3	40	9
8 ..	..	..	45	55	2	2	..	..	..	..	Pedigree white clover	3	51	39

In regard to the seed-mixture trials under sheep management, these were sown in the autumn of 1934 on rather wet, stiffish country that if neglected runs back to rushes, brown-top, and sweet vernal. The botanical composition of these mixtures is shown in Table IV, and it will be noted how dominance has been attained by perennial rye-grass - white-clover and how poorly most of the subordinate species have contributed to the sward. Here again it will be noted that strains in those species that are likely to be dominant is important. The white clover sown in the general base is a certified permanent-pasture strain, and it has performed remarkably well. At the time of the analysis (May) it will be noted that, on the whole, production is virtually equal to ground-cover excepting where no white clover was sown and a volunteer white clover of an apparently poor type appeared (Plot 11) and where the Kent wild white clover was sown (Plot 13). Here the actual production figure is considerably lower than the ground-cover figure.

Table IV.—Botanical Composition of Plots sown down to various Seed-mixtures, Autumn, 1934, and since utilized under Good Sheep and Cattle Management, Terrace Country, Massey Agricultural College

Plot.	Base Seed-mixture.										Montgomery Red (3 lb.).		Additional Species.			
	Italian Rye-grass (5 lb.).		Perennial Rye-grass (25 lb.).		Akaroa Cocksfoot (6 lb.).		Dogstail (3 lb.).		White Clover (3 lb.).							
	A.	B	A.	B	A.	B	A	B	A	B	A	B		lb	A	B.
1 ..	Tr.	Tr.	33	53	14	5	0		40	28	12	13	Base only	.		.
2 .	,,	,,	37	39	7	6	0	.	37	37	16	13	Italian	15	Tr	Tr.
3 ..	,,	,,	33	40	.	6	0		41	38	22	13	,,	10	,,	,,
4 ..	,,	,,			4	2	0		37	28	24	9	Station perennial	25	33	58
5 ..	,,	,,	38	47	2	2	0		43	37	10	12	Timothy .	6	3	1
6 .	,,	,,	42	38	4	2	1		31	42	21	17	Brown-top	2		2
7 ..	,,	,,	46	60	3	1	0	.	36	33	13	5	Subterranean clover	4	0	0
8 ..	,,	,,	35	37	4	9	0		39	41	20	12	Subterranean clover (Austral'n)	4	0	Tr
9 ..	,,	,,	42	50	8	3	0		19	46			No red alsike	3	0	0
10 ..	,,	,,	39	39	5	7	1	.	42	37	11	12	*Lotus major* .	1	0	0
11 ..	,,	,,	44	68	2	3	2		16	5	31	21	No white sown			
12 .	,,	,,	35	36	5	2	0				17	8	Certified mother white	3	42	52
13 ..	,,	,,	43	53	4	4	1				13	22	Kent white	3	36	20
14 ..	,,	,,	34	22	6	3	0				12	13	Pedigree white	3	48	62
15 .	,,	,,	42	56	4	1	1		17	39			Broad red .	3	4	3
16 .	,,	,,	36	52		.	1	.	40	36	8	7	Aberystwyth pasture cocksfoot	6	11	3
17 .	,,	,,	30	50		.	0		38	30	19	9	Aberystwyth dual cocksfoot	6	12	10

In the case of the certified "mother" seed and pedigree seed the production figure exceeds ground-cover figure, and this is a vital point when the carrying-capacity of the country comes to be considered. It will be noted that all the subsidiary additional species have fared badly, and even cocksfoot has been hardly worth while. The contribution from Montgomery red clover compared with broad red clover is significant (Plot 15), and the inclusion of Montgomery red clover would appear well worth while.

TRIALS AT WHANGAMOMONA.

Turning now to secondary-growth hill country sowings, the principle of the comparatively simple mixture holds good. In the course of the regrassing experiments in the control of secondary growth at Whangamomona over eighty species of grasses and clovers were sown, and in one mixture over fifty species were used. The outcome of that work was the drawing-up of a seed-mixture the species of which could be counted on one hand.

Some complex seed-mixtures that were sown and the resultant swards produced as a result of the seeding are shown in Table V. It will be noted that of the fifteen species used only three are contributing well after three years down, with volunteer species and weeds ranking higher in importance than the greater number of species sown. The danthonia in the mixture is in its early stages of aggressive development.

Table V.—Showing Composition of Swards sown out in various Mixtures for Secondary-growth Burns Three Years after sowing down, Whangamomona

Mixtures (Pounds per Acre).	1.	2	Ground-cover after Three Years.			
			Mixture 1.			Mixture 2
Cocksfoot	8	..	2	1	1	4
Crested dogstail	4	6	12	9	10	12
Perennial rye-grass	6	4	2	3	2	3
Italian rye-grass	2	..	..	..	..	..
Poa pratensis	0½	..	..	0·2	1	1
Brown-top	2	1	32	55	48	38
Danthonia	1	3	8	1	5	0·2
Paspalum	2	2	1	6	1	4
Chewing's fescue		..	2	1	..	0·5
White clover	1	2	4	2	10	1
Lotus major	½	1	14	37	6	34
Lotus hispidus	0½	1	2	0·2	0·4	2
Red clover	1	2	..	..	1	1
Subterranean clover	0½	1	..	1	1	4
Yarrow	0⅛	0⅛	1	0·2	1	1
Suckling clover	(Volunteer)		6	3	5	3
Yorkshire fog	,,		6	3	5	3
Catsear	,,		11	4	9	10
Other weeds	,,		5	5	16	11

Further evidence of the simple seed-mixture and its economy may be seen in the case of seed-mixtures for playing-greens, lawns, &c. In this connection mixtures were land down in 1932 at the Green-keeping Research Station at Hokowhitu, and these were analysed by the point and dissection methods in May, 1936, four years after sowing. The plots were managed for the whole of the period as a green in play, cutting being close and continuous. Manures and chemicals were applied to control weeds and clover and to maintain soil fertility at a standard that maintained equilibrium between the brown-top - Chewing's-fescue combination. The results are seen in Table VI.

Here it will be noted little or no improvement to the ultimate sward is secured by the lavish expenditure on seeds additional to that simple brown-top - Chewing's-fescue mixture, although it must be stated that crested dogstail and perennial rye-grass figured in the sward

for upwards of two to three years. The main point, however, is that simplicity follows the setting-up and maintenance of a stable environment. Control of the environment must be the aim of every grassland farmer, and it is for him to learn how best to create a stable environment that will produce the maximum quantity and quality of edible herbage. Land development in New Zealand by the State and by the individual farmer each year points clearer and clearer to the fact that the goal to grassland attainment is an environment that is conducive to the rise and stabilization of the simple perennial rye-grass - white-clover - dominate sward, aided and abetted may be by special-purpose pastures that are simple in fact and single in purpose.

Table VI.—Showing Details of Turf Analyses at the Green-keeping Research Area and comparing these with the Seed-mixtures sown

(Sown March, 1932; analysed May, 1936. A = Point analysis, B = Percentage composition.)

Plot.	Base Mixture.				Additional Species with their Contribution to the Sward.			
	Brown-top (120 lb. per Acre).		Chewing's Fescue (240 lb. per Acre).					
	A.	B.	A.	B.		Lb.	A.	B.
1 ..	51	40	63	49	Base only ..	..	..	..
2 ..	55	47	54	47	*Poa pratensis* ..	240	2	2
3 ..	65	57	43	38	Crested dogstail ..	240	1	1
4 ..	64	57	41	36	Certified perennial rye-grass	240	..	..
5 ..	71	61	44	38	*Danthonia pilosa* ..	240	..	..
6 ..	70	50	54	39	Yarrow	40	9	7

ACKNOWLEDGMENTS.

For assistance in the field-work in connection with this paper I am indebted to Messrs. E. A. Madden and P. D. Sears for botanical analyses, and to Messrs. J. W. Woodcock and W. B. Wards for field experimental data obtained at Marton.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 13th August, 1936, to 8th October, 1936, include the following of agricultural interest:—

No. 74927: Weed-killing apparatus; W. Jefferies. No 74999: Drinking-trough, I. G. Frandi. No 76009: Milk-bottle container, H. W Van Buskirk and O. Beaulieu. No. 17620: Teat-cup, T Shiels. No 74721: Manure-distributor, T. H. Groves. No. 76349: Milking-apparatus; S. Turner, Ltd, A. F. Plint, G. H. Gascoigne, J R Knox, and J A Kingston. No. 74681: Flax-dressing; N. I. Gooder. No 74879: Harrow, J. E. Holland. No. 75318: Animals, feeding; O. Gurtner and W. A. Meister. No 75399. Shearing-machine fork; J. Davidson. No. 75556: Grain-treatment, Sunbred Ltd. No. 76076: Flax-dressing; cognate with No. 74681. No 76540: Grain-separator; J. S. Robertson. No. 76460: Harrow; C B Idle No. 76494: Spray-pump; S. E. and S. G. Holland. No. 76627. Cream and butter treatment; F. D. Fogarty and J. Black.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

SOME ASPECTS OF THE EXTREME SIMPLIFICATION OF PASTURE-SEED MIXTURES.

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A STUDY of grass-seed mixtures used during the past two hundred years reveals that there is relatively little new in the present-day trend towards the extreme simplification of such mixtures, and that during this period the pendulum has swung backwards and forwards. It is an accepted theory that extremes in anything are not desirable.

As an indication of how history repeats itself in this matter might be cited the advice tendered by various eminent authorities at different periods during the past 200 years. Mr. Arthur Young(1) about the year 1760 stated: " I may safely assert that a judicious farmer will by means of clover and rye-grass maintain nearly as many sheep on 300 acres as before were kept on a thousand."

The mixture recommended by Young was 10 lb. red clover, 8 lb. white clover, 6 lb. yellow clover, and 1 bushel of rye-grass, and incidentally the composition of this mixture would lead one to suppose that the importance of clovers to the pasture sward was fully appreciated at that early period. A little over a hundred years later mixtures containing up to twenty species were advocated, and as an instance of a mixture of the times might be quoted Elliot(2), who recommended for general pasture purposes—cocksfoot, 10 lb. ; tall fescue, 3 lb. ; crested dogstail, 2 lb. ; hard fescue, 3 lb. ; *Poa pratensis*, 2 lb. ; golden oat grass, 3 lb. ; burnet, 3 lb. ; chicory, 1 lb. , parsley, 1 lb. ; rib-grass, 1 lb. ; yellow clover, 1 lb. ; kidney vetch, 1 lb. ; lucerne, 2 lb. ; red clover, 2 lb. ; white clover, 3 lb. ; alsike clover, 1 lb. ; yarrow, 1 lb. ; and birdsfoot trefoil, 1 lb.: making a total of 39 lb. per acre. To-day, some sixty years later, we have grassland authorities recommending the sowing of one or at most two species. Stapleton(3) states that " A man starting on the poorest of poor soils would be doing nothing outrageous if he sowed wild white clover and nothing else. A man starting on fairly good soil, and where he expected white clover to volunteer freely, would be doing quite a sensible thing to put all his money into leafy perennial rye-grass and sow nothing else."

While apparently none of our New Zealand grassland workers have gone to such an extreme as Stapleton in the simplification of mixtures, there is nevertheless an indication that some are trending this way, and that species other than perennial rye-grass and white clover are regarded merely as incidentals to rather than necessary and desirable component parts of pastures. Such workers realize the shortcomings of a pure rye-grass - white-clover sward (although they do not realize them to the full), and to set off these weaknesses advocate the sowing of other paddocks with other pure sowings or selected species, such as cocksfoot, &c., dominant in a simple mixture. The theory behind this procedure is to provide variety and prolonged growth by having on the farm a series of paddocks practically of a one grass and clover association, each designed to cater for a particular season and a particular purpose.

If in the light of experience it has been found advisable to have dominant rye-grass, or dominant cocksfoot, or dominant any "other grass" paddocks, this objective surely can be achieved by merely

increasing the quantity of the required species in the mixture, and there would appear to be no real reason for the use of almost pure sowings on this account. It is contended by some that undue competition in a mixed pasture results in some species being entirely smothered, but it is suggested that this smothering is not nearly as great or serious as some would have us believe. Frequently one sees a pasture at a certain season of the year dominant with a certain grass, while at another period some other grass or grasses are dominant. Then again the following season conditions may be such that some individual grass that was thought not to have survived in the sward makes its presence felt on account of the peculiar conditions suiting its nature. It is quite conceivable, therefore, that in a mixed pasture certain grasses may be lying more or less dormant for long periods, merely waiting for a suitable opportunity, through unusual conditions, to become prominent. Thus a mixed pasture provides a measure of insurance against abnormal conditions that cannot be provided for in pure or nearly pure sowings. The variation that a mixed pasture provides for stock is perhaps a more important factor than it is generally given credit for Levy(4) has stated, "Palatability, therefore, must be looked upon as a variable thing, and the palatability of a food will depend very largely on its relative mass in comparison to other foods." How then can we expect the palatability factor to be anything but unsatisfactory in a pasture 80 per cent. to 90 per cent. of which is composed of one variety of pasture-plant? The very unfavourable reports that are fairly common in Otago and Southland with regard to lack of palatability where certified rye-grass has been used can in most cases be traced back to pastures composed principally of rye-grass with very little of other grasses and perhaps clovers This is only too obvious in those paddocks that have been sown down for seed-production where a pure sowing of rye-grass has been made. This may be an extreme illustration of the present-day simple mixtures, but nevertheless in these cases the degree of trouble lessens as grasses other than rye-grass and clover increase in the sward. On account of this lack of palatability in a pasture where rye-grass (or any other one grass) is dominant to a very marked degree, it is considered that in all probability 10 lb to 15 lb. of certified rye-grass rather than 20 lb. to 25 lb. in a pasture mixture will develop into a general practice in the future, with other species being slightly increased to give the necessary seeding per acre. Probably if farmers in the far South sowed less certified rye-grass in the mixture than they have been encouraged to hitherto, much of the opposition to this class of seed would disappear. That there are authorities at Home holding this viewpoint is indicated by Cruickshank(5), who states: "Wild white clover along with a suitable mixture of perennial rye-grass and natural grasses makes a pasture beyond comparison of those of fifty years ago. The seeds sown were generally 30 lb. to 40 lb. perennial rye-grass, only occasionally a few natural grasses, and 4 lb. to 6 lb. of clover. Now, by reducing the perennial rye-grass to 14 lb. to 16 lb. and adding a proportion of natural grasses and 1 lb. of wild white clover, a marvellous change has been brought about." The greatest drawback, however, to the

sowing of simple mixtures in various paddocks for various purposes, and one that to my mind rules the system right out as far as its practical application is concerned, is in the high efficiency of pasture-management that is necessary to obtain successful results. Farming efficiency on even our best-managed farms does not stand at a very high figure. Wilkins(6) in a recent book stated that, "American agriculture is only 11 per cent. efficient judged on the scale of most efficient methods, while the co-efficient of most European countries would be below 30 per cent." Granted that our most efficient grassland farmers have no peer in any other part of the world, their standard of efficiency would possibly be well below 50 per cent. This knowledge that farming efficiency throughout the world is relatively low is no reflection on the ability of the individual farmer, but is rather an indication of the many and varied adverse factors of Nature that he has to contend with in his farming practice. For instance, seasons are by no means constant: if they were farming efficiency would possibly be brought to a very high standard. If spring definitely started on a certain date with a certain temperature, and this was followed at regular intervals by regular rainfall, with certain known temperatures, all of which in turn would produce a known quantity of grass, grassland farming could be worked out to a very fine art, and it would be within the reach of every farmer to provide stock when and where it was required to deal with the growth, or conversely to grow the grass at certain times to suit the stock. In practice, however, growth and stock numbers frequently fail to bear the desired relationship one with another.

Throughout Otago and Southland, as well as in many other parts of New Zealand, there are on certain farms pastures resulting from more or less pure sowings, as well as pastures put down with very general mixtures, and during the past autumn a fairly extensive survey was made of such pastures to see just what the position was with regard to production. Unfortunately, no farms working on the "one paddock one pasture type" system are known to be in existence, so that no fair comparison could be made; nevertheless the following data in connection with some of the pastures rather prove the value of the mixed pasture under efficient pasture-management methods.

Titipua Pastures.—These pastures are recognized as some of the finest pastures in Southland, and definitely come under the heading of mixed pastures. The mixture sown is somewhat as follows, quantities per acre being varied in some of the minor details at times: Certified perennial rye-grass, 25 lb.; Italian rye-grass, 10 lb.; timothy, 3 lb.; cocksfoot, 5 lb.; *Poa pratensis*, 1 lb.; *Poa trivialis*, ½ lb.; white clover, 3 lb.; Montgomery clover, 1 lb.; yarrow, 1 oz.: total, 48½ lb.

Most of the paddocks are dominantly rye-grass and white clover, but there exists in the sward in varying quantities cocksfoot, *Poa pratensis*, timothy, brown-top, red clover, dogstail, fog, yarrow, *Poa trivialis*, and hydrocotyle. Incidentally, it is intended to increase the timothy sown in this mixture. These pastures are mixed pastures, they have a high carrying-capacity, and fat lambs are got away with despatch. After seeing these pastures one is tempted to suggest that a

small quantity of brown-top should be included in all mixtures where sheep are grazed and where fat-lamb production is practised. It would be surprising to learn that Mr. Phillips's pastures at Marton, where over nine ewes to the acre are carried, are free of brown-top.

Winton Experimental Farm.—A five-year-old paddock that fattened nine lambs per acre off their mothers this season is principally a rye-grass-white-clover sward, but has also dogstail, timothy, cocksfoot, and red clover present in fair quantities.

Bowmar Bros., Gore, who are recognized in the district as very good farmers and whose production-figures are high, sow (in pounds per acre): certified perennial rye-grass, 30; Italian rye-grass, 5; certified cocksfoot, 10; dogstail, 2; white clover, 2; Montgomery red clover, 2: total, 51. The existing sward is roughly 50 per cent. rye-grass, 30 per cent. white clover, 15 per cent. cocksfoot, 2 per cent. timothy, 3 per cent. fog, dogstail, and weeds.

D. Gunn, Winton, is considered to be a progressive farmer whose pastures as a whole are very mixed and whose production-figures are high. One of his best pastures is dominantly brown-top, rye-grass, white clover, and dogstail, with a fair amount of *Poa trivialis*.

W. J. Cowie, Centre Bush, sows only rye-grass 33 lb., white clover 3 lb. per acre. Pastures are dominantly rye-grass, white clover, but contain a good deal of dogstail and brown-top and traces of fog.

W. Young, Drummond, considers his best paddock to be dominantly rye-grass, white clover, and cocksfoot, with some timothy and brown-top. On this paddock the cocksfoot is outstandingly good. This farmer sows (in pounds per acre): perennial rye-grass, 15; Italian rye-grass, 5; meadow fescue, 10, timothy, 4; cocksfoot, 4; white clover, 2; alsike, 2; dogstail, 1; red clover, 2: total, 45.

The position with regard to North Island pastures generally is known to be somewhat the same, production (and general satisfaction) being greater where a mixed pasture of good grasses exists. The one outstanding farm in Taranaki, where during the past season the production was almost 350 lb. of butterfat per acre, has pastures of a very mixed nature. In 1930, when production on this farm stood at 300 lb. per acre, the best paddock, when point-analysed, gave the following results (figures being hits recorded): perennial rye-grass, 26·00; white clover, 17·25; cocksfoot, 5·50; dogstail, 2·50, *Poa trivialis*, 1·50; red clover, 0·25; *Poa pratensis*, 25·00, suckling clover, 0·25; *Lotus major*, 0·25; Yorkshire fog, 4·75; foxtail, 6·25; sweet vernal, 15·50. In the case of this pasture rye-grass and white clover represented 36 per cent. of the sward, and it is quite an open question whether any great increase in this figure would be any advantage.

All the pastures quoted, and they are just typical of hundreds of others, can be safely said to be mixed in character, and have been evolved under systems of management of a practical nature apparently suiting the conditions as they exist, and returning to the farmers concerned profitable and apparently satisfactory returns. Are these farmers to throw away the very real "substance" of the mixed pasture for the "shadow" of a system of grassland farming that is far from convincing, has not yet been proved, and, to the minds of many, lacks practical application.

In conclusion it should be made clear that the statements herein do not cover country where, owing to various factors, the establishment of a mixed pasture may prove difficult and unsatisfactory. It is recognized that there exist in New Zealand tracts of country that are suitable for only one or two species, and where these conditions exist such pure species or simple mixtures must be relied on almost in their entirety.

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NOTES ON THE ARSENICAL POISONING OF LIVE-STOCK.

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THE loss of stock through poisoning is a matter of considerable economic importance, and personal experience indicates that losses due to arsenical poisoning are by no means as uncommon in New Zealand as they might be.

ARSENIC.

Arsenic belongs to the class of mineral or inorganic poisons, and has a wide occurrence in Nature, the chief sources being the yellow sulphides —*e.g.*, arsenical pyrites, a double sulphide of iron and arsenic.

Arsenious oxide, AS_4O_6, erroneously termed "arsenious acid" and commonly known as "white arsenic," or, in the trade, just "arsenic," is obtained by roasting certain arsenical ores. With its salts, this is the commonest form of arsenic. Arsenious oxide is sparingly soluble in water, but the alkali salts, together with the alkali thio-arsenites, in which oxygen is in part replaced by sulphur, are readily soluble.

SOURCES OF ARSENIC ON THE FARM.

The most common source of arsenic is probably the various dipping powders, pastes, and fluids used for the purpose of destroying ticks and lice in sheep and cattle. The majority of these preparations contain arsenic as their active ingredient, generally in the soluble form of sodium arsenite. According to Lander such "dips usually contain about 20 per cent. of soluble arsenic and 3 per cent. of insoluble arsenious sulphide, which is held to exercise a protective effect during the intervals between dipping. After solution for use the strength of soluble arsenic lies between 0·25 per cent. and 0·5 per cent."

Arsenic is used in some remedies for the treatment of foot-rot in sheep, and sometimes in solutions used in baths for the prevention and treatment of foot-rot.

In various weed-killers, solutions of sodium arsenite have been used.

Arsenic is also used in vermin poisons, in some preparations used for spraying trees, and in dressings for seeds—*e.g.*, wheat.

In medicinal doses arsenic is a tonic and alterative. It stimulates the gastric mucosa, improves digestion, and increases the appetite. It diminishes oxidation and increases the formation of fat. In horses, especially, it gives a certain plumpness and sleekness to the skin. For this latter reason arsenic is frequently administered to horses by grooms, trainers, &c. It is a common ingredient of various condition powders which are in great demand at times.

Arsenical sheep-dipping fluids are used for the destruction of fly larvæ on manure, &c., especially in the vicinity of stables in towns.

The Toxicity of Arsenic.

The arsenites are the most toxic of the ordinary arsenical preparations. Coarsely powdered white arsenic, which is sparingly soluble, is much less toxic than the readily soluble sodium and potassium salts: it is recorded that 270 grains of coarsely powdered white arsenic failed to kill a dog, but $\frac{9}{10}$ grain of potassium arsenite and $2\frac{1}{4}$ grains sodium arsenite proved fatal when given by the mouth. According to Kaufmann, 45 to 60 grains of the dissolved oxide will kill a horse, whereas 675 grains of the solid is required.

In solution, and particularly in the form of the alkali salts, and in very fine division the arsenious compounds are most readily absorbed and most toxic. The approximate lethal doses in grains of arsenious oxide (in the form of sodium arsenite) are—horse, 30 to 45; cow, 30 to 60; sheep, 6 to 10; dog, 5.

Method of Absorption of Arsenic.

The location of the absorption of a poison has a distinct bearing on the degree of its effect. Absorption may take place by any portion of the natural food tract, through the skin, or by the respiratory tract.

By the Digestive Tract.—The food tract is the most usual place for absorption to take place, chiefly through the stomach and intestine, on account of the more delicate lining membrane of these parts.

The absorption of dissolved arsenic through the mucous membrane of the digestive tract is very rapid, but, unlike the effect of corrosive poisons, there is a definite latent period before the effects of arsenic are apparent. Access to arsenic, in order that absorption may take place in this way, is through the contamination of food or water, or possibly from the surface of the skin in the case of animals licking themselves after spraying or dipping.

Arsenical poisoning of sheep has been known to follow the ingestion of pasture which has been contaminated by the drippings from the fleece after dipping. Clough records " A mysterious case of arsenical poisoning in bullocks was explained by the fact that the animals had grazed on long grass in a field into which sheep had been turned out after having walked through a foot-bath containing arsenical dressing for foot-rot. Cattle have died from arsenical poisoning after drinking from a trough which has contained an arsenical dressing for foot-rot in sheep." This year in Dunedin a case of arsenical poisoning in horses resulted from contaminated drinking-water. The details of this case are of practical interest.

Out of four horses, A, B, C, and D, three worked on a certain Saturday morning and partook of their midday meal after return to the stable. All refused their evening meal, but no special notice was taken of this, as a new line of chaff was commenced that day. About 3 a.m. on the Sunday morning the yard-man heard unusual sounds from the stables. On rising to investigate he found two of the horses (A and B), both aged geldings, uneasy and in some pain; one of them was down and groaning. Subsequently both horses became very dull and depressed, with a marked increase in respirations. Exhaustion followed rapidly, and A collapsed and died at 5 a.m. The horse B followed the same course at noon, but became delirious before death.

About this time another eight-year-old black gelding C was seriously ill. This horse I saw, and it was obvious he was not likely to recover. When seen he was standing in his stall in an alarmed state, temperature 104 (normal temperature of a horse 100), increased respiratory action, conjunctival mucous membranes deeply injected, no pulse at all, heart-beats approximately 80 per minute, shallow beats with arrhythmia, no salivation, no diarrhœa or marked colic. The fourth horse, D, was also ill, but not to the same degree, the most marked symptoms being dullness, inappetence, temperature 101·6, cardiac arrhythmia, and a thready pulse.

The sudden onset of illness of such an alarming character, and the fact that four horses were involved, indicated poisoning. Experience suggested arsenical poisoning, and on this tentative diagnosis the horses C and D received approprate treatment. C lasted without any marked change until the Tuesday morning, when he collapsed and died. D eventually recovered. The first two horses to die were subjected to post-mortem examination, and both presented very much the same picture. The most pronounced lesion was intense gastritis, slight enteritis of a patchy nature, most marked in the horse A in the cæcum, petechial hæmorrhages in the pericardium and visceral peritoneum, passive congestion of the lungs. Both horses had a post-mortem rupture of the diaphragm.

Samples of the food and water and the stomach contents of the first two horses to die were retained for chemical analysis. Mr. L. H. James, M.Sc., A.I.C., Government Analyst, Dunedin, reports as follows on the analyses of the samples:—

> The drinking-water (J/259) contains arsenic equivalent to 0·738 grams of arsenious oxide per litre (51·7 grains per gallon). I estimate the fatal dose of arsenic for a horse at from 30 grains upwards. The arsenic is not present in the water as arsenious oxide (or "white arsenic"), but is in solution as sodium arsenite. This is the form in which it occurs in sheep-dip. A small quantity of tar acids was also present in the drinking-water. This is also consistent with the presence of sheep-dip in the water.
>
> The stomach contents (J/255 and J/257) both contain arsenic.
>
> The chaff (J/260) contains no sheep-dip and no "white arsenic."

An arsenical sheep-dip was in use in the stable for the purpose of spraying manure in order to destroy fly larvæ, a practice in use for some years past. The horses drank in the yard from a barrel, which held

about 33 gallons of water, and, if this was full at the time, at least ½ pint of sheep-dip must have got into it. Presumably at midday Saturday the horses took in 51·7 grains of arsenic with each gallon of water consumed. The use of an arsenical sheep-dip in and about a stable is a questionable procedure at any time, and, if it is necessary, this case illustrates the necessity for the exercise of absolute care.

In another case noted two good draught horses were lost from arsenical poisoning. Material, which originally had been taken from a tree-spraying machine, was wheeled in a barrow across a paddock; in doing this the pasture where the horses grazed was contaminated.

By the Skin.—The normal secretion of the skin is fatty. An alkali saponifies a fat and emulsifies it, thus alkaline solutions of arsenic, such as are used in dips, increase the risk of penetration if left in contact with the skin too long, and especially if the solutions are too strong. Arsenic from a sheep-dip is absorbed by intact normal skin only in relatively small amounts The well-known proprietary dips are of standard uniform strength, are in universal use, and every safeguard is taken against any danger attendant upon their use, providing strict attention is paid to the directions and the method of procedure is carried out judiciously and correctly in accordance with the makers' instructions. Nevertheless, if animals be dipped or sprayed with arsenical solutions that are too strong, or if they are dipped or sprayed when hot through being driven, &c , poisoning through the absorption of arsenic by the skin may occur.

Clough records the following case in England: "A farmer accidentally prepared too concentrated a solution of a liquid arsenical sheep-dip and applied it to the necks of twenty-eight cattle, ten of which died of acute arsenical poisoning. Chemical analysis of the skin and viscera indicated that the poison had been absorbed through the skin."

In 1929 in Otago eighteen pedigree cattle were sprayed with a solution of a well-known arsenical-paste sheep-dip, and this in spite of the fact that the manufacturer's instructions clearly stated on the label on the drum that on no account must horses, cattle, or dogs be sprayed or dipped with the paste. Incidentally the directions on the drum stated that 1 lb. of the paste should be mixed with 10 gallons of water. Instead of this quantity of paste being weighed, a flat piece of board was used to ladle out an indefinite quantity for mixing with the water. In fact, there was glaring carelessness throughout. All the animals concerned exhibited symptoms of arsenical poisoning, and three died. In this case absorption, in the main, was through the skin, a definite eruption was noted, particularly inside the thighs and round the scrotum and mammary gland. The words "in the main" are used because there is a possibility of ingestion, as cattle, like dogs, lick themselves, and, to a lesser degree, horses also.

In 1935 in a further case recorded in Otago by Mr. A. L. Thompson, M.R.C.V.S., four horses were involved. They had been dressed for lice with a solution of sheep-dip, although warnings have been issued from time to time in this *Journal* that arsenical sheep-dipping solutions should not be used for this purpose. All the horses exhibited symptoms of acute arsenical poisoning, and one horse died.

Absorption of arsenic from the broken skin is naturally far more rapid than from the intact surface. In regard to this Lander states,

"The difference is well illustrated by Kaufmann's figures for the toxic doses of powdered arsenious oxide for sheep, which are by the mouth 75 grains, and by application to a wound 3 grains."

SYMPTOMS OF ARSENICAL POISONING.

Firstly arsenic is an acute irritant poison producing in all animals gastro-enteritis. In general, in acute poisoning there is loss of appetite, thirst, and severe colicky pains, irregular heart action, with an imperceptible or weak irregular thready pulse, visible mucous membranes are highly injected, acute depression, exhaustion, death occurring in a variable period, with symptoms of coma or with tetanic spasms.

Apart from extreme debility, there may be noted paralysis of the hind extremities, coldness of the ears, and trembling, stupor, and convulsions. In prolonged cases giddiness, muscular tremors, colic, and coldness are prominent. In cases of absorption through the skin there is a scalded appearance, with a purply red eruption, later with sloughing in patches, similar to some extent to arsenical eruption in man.

TREATMENT.

A first objective is expulsion by oily purgatives—*e.g.*, raw linseed oil in the horse and ox. As specified antidotes, calcined magnesia and freshly precipitated ferric hydroxide are used. In dealing with an emergency case of arsenical poisoning in the ox, horse, or sheep, one may precipitate tincture of iron perchloride with soda carbonate, filter through a handkerchief and give *ad lib* in warm water at intervals of ten minutes. Demulcents, such as oatmeal or starch gruel, linseed tea, milk and eggs, or milk alone, should be given. Copious warm enemata promote peristalsis and excretion. Any skin application such as dip must be washed off, preferably by soapy water. Hypodermic injection of morphia is desirable if there is much pain.

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An endeavour to make better provision of feed is indicated in the fact that the sales of lucerne culture by the Department have been record ones and sufficient to treat the seed required for the sowing of approximately 8,000 acres. After making allowance for the area of previously established lucerne which goes out of production annually on account of its age, &c., the sales of lucerne culture point to an increase in the total Dominion acreage of lucerne. At the same time, the apparent increase at best is only a few thousand acres, and, while welcome as a continuation of the steady increase in the Dominion acreage of lucerne which has been going on for several years, it is much less than the intrinsic merits of the crop justify. Our knowledge of the requirements of lucerne and of its culture under local conditions has become sufficient to enable the failures with the crop that occurred fairly often in the past to be avoided, provided advantage is taken of the conclusions which have been drawn from accumulated field experience and from field trials.—*Annual Report, Director-General of Agriculture.*

TOP-DRESSING IN SHEEP-FARMING ON ROLLING COUNTRY IN THE HASTINGS DISTRICT.

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OFFICIAL figures showing the amount of artificial fertilizer delivered at officered railway-stations in Hawke's Bay over the period 1928-29 to 1935-36 are as follows:—

Year.	Tons.	Decrease relative to 1928.	Increase or Decrease relative to 1931-32.
		Per Cent.	Per Cent.
1928-29	18,752	..	..
1929-30	13,677	27	..
1930-31	13,889	26	..
1931-32	13,280	29	..
1932-33	11,899	36	10 (decrease).
1933-34	13,809	26	4 (increase).
1934-35	18,757	..	41 (increase).
1935-36	16,405	..	23 (increase).

These figures indicate a steady decrease in the amount of fertilizer brought into Hawke's Bay from the peak year, 1928-29 to 1932-33, since when there has been a steady increase up to the present time. It appears, therefore, that the amount of fertilizer brought into Hawke's Bay has strictly coincided with the prosperity of the community. That this is so is frequently borne out by farmers, who say that they usually top-dress but have not done so during the slump, although they have recommenced this season.

The indications from the farm-management survey at present being conducted by the Department of Agriculture in the area under discussion are that, in general, the amount of top-dressing done is relatively small. Of the total of about ninety farms so far visited, only one farm has been seen where the total area of the holding is top-dressed each year, although most farmers interviewed agree that top-dressing gives good results and pays for its application. About 10 per cent. of the farmers visited do no top-dressing at all, while farms, on similar country around them, are at least receiving a certain amount. The reason advanced in nine cases out of ten is not that manures do not give a response and pay for their application but that the farmer is not in a financially sound enough position to expend money in this direction.

It seems that, with the increasing dissatisfaction with the rape crops being obtained, due to attack from pests, there is a trend to the top-dressing of grassland and the growing of subterranean clover, so that an increasing percentage of lambs may be turned away fat off the mothers. Many instances are on record where this has already taken place.

In general, in the area under review, superphosphate is the only fertilizer applied. On some of the higher rainfall country basic slag is being used, but not commonly. Potash and nitrogen are practically never used, and lime is used by about 20 per cent. of the farmers.

The tendency is, on the lighter land and under rainfall conditions of over 35 in., to apply anything between 1 cwt. and 3 cwt. of fertilizer per acre. Fertilizers are nearly always applied in the autumn, usually about April.

METHOD OF APPLICATION.

Large areas of the district under discussion are suitable for top-dressing through a manure-broadcaster, either drawn by horses or by tractor. Much of the country, however, is of such a nature that top-dressing must be done by hand. The average area which can be top-dressed by a distributor, on country over which the distributor can pass without much trouble, is 10 acres to 12 acres per day. Areas top-dressed by hand vary between 7 acres and 10 acres per man per day, depending on the rate at which the fertilizers is being applied and the nature of the country to be traversed.

EXPERIENCES AND COMPARISONS ON SELECTED FARMS.

EXAMPLE I

Farm A: Top-dressed (3 cwt. per acre on 350 acres); Farm B: Untop-dressed.

Rainfall: Approximately 50 in. annually, with approximately 125 rainy days.

Farm A.—This property, 1,143 acres in area, was taken up eight years ago, and top-dressing was commenced in the following year. The place was largely covered with fern and scrub, which has had to be cleared and ploughed before good grasses could be sown. In its untop-dressed state this type of country does not hold good grasses and clovers for more than three or four years, when the pasture becomes invaded with brown-top, fern, and scrub. When the property was first taken over it carried 500 sheep. In 1928–29, when top-dressing was commenced, it carried 800 sheep, 500 of which were breeding-ewes, the balance hoggets. The average lambing percentage at this time was 55 per cent. to 60 per cent. To-day, with the clearing and sowing-down and subdivision, 1,100 breeding-ewes are being carried, with an average lambing from the ewes of 85 per cent. to 90 per cent. So far no change-over from breeding to fattening has taken place, as stock numbers are steadily increasing and the surplus ewe lambs are required each year to supplement the ewe flock. It is anticipated from results so far obtained that three ewes per acre will be carried and surplus lambs fattened. It has been calculated that, over the eight-year period, an increase of 3 lb. of wool per head has been obtained, and the quality greatly improved.

Pastures which have been down for six or seven years show no deterioration, the paddocks tending to improve rather than to degenerate, as was the case before top-dressing was commenced. Increased consolidation and fertility owing to higher stock numbers contribute to this. Manure always is sown with the seed to give the young plants a good start—a thing which one feels is not common enough in Hawke's Bay, where a fairly late sowing is usually made after rape.

Farm B.—This farm, 1,595 acres in area, is probably better land than Farm A, although it is harder to work in that much of the country is unploughable and would have to be top-dressed by hand. This property, on the 1,600 acres, was carrying in 1935 1,070 sheep, a decrease steadily taking place after 1925, when 1,400 sheep were carried. Lambing percentages range from 70 per cent. to 80 per cent. Wool clip averages 7 lb. per head. No top-dressing is done at all.

Comparison.—Farm A is carrying 1,600 sheep on 1,143 acres, showing an advance in eight years of 1,100 sheep. Practically the whole of these sheep are being carried on the top-dressed portion of the farm, which represents only 350 acres out of a total of 1,100, or approximately one-third.

Farm B is carrying 1,070 sheep on 1,595 acres, and stock numbers have, over a ten-year period, remained approximately constant, with a slight tendency to decrease. Farm A has an average lambing percentage of 85 per cent. to 90 per cent.; farm B, one of 70 per cent. to 80 per cent. Farm A clips 9 lb. of wool per head; farm B, 7 lb.

EXAMPLE 2.

Farm A: Top-dressed (1¼ cwt. per acre on 800 acres). Farm B: Untop-dressed.

Rainfall: 35 in. annually, with an average of 112 to 125 rainy days.

In this case, no farm can be found that is sufficiently like it in size and condition to warrant any comparison being made, but country essentially similar to that which is being top-dressed is carrying half to three-quarters of a sheep per acre at the present time.

On this property, which is 2,439 acres in area, having 1,300 acres of flat land, previous to the top-dressing, subdivision, and the planting of shelter-belts all wet sheep were carried entirely on the hill country, the flats carrying wethers and hoggets only. The flats were subdivided into three sections—640 acres, 400 acres, and 250 acres in area. This total area has since been further subdivided into fourteen paddocks. On 150 acres of the 640-acre section only 200 wethers were carried, and in another block, 250 acres in extent, 260 very late lambing and empty ewes were run from January to May. This section was ploughed out of gorse and scrub eighteen years ago, and little subdivision and no top-dressing has been done. In all the other paddocks of the flat land, which have been reduced in size by fencing and sheltered as well as top-dressed, three to five ewes can be run from July to January and cattle in the spring, and cattle and ewes while the rams are out, from the beginning of March to the end of April. From the end of April to the end of July the paddocks are grazed with hoggets.

On the farm as a whole, before the improvements mentioned took place, 1,000 ewes and 1,500 dry sheep, made up of 1,000 hoggets and 500 wethers, were carried. This has increased to 3,100 breeding-ewes, 100 wether lambs, 1,120 hoggets, and 85 rams. Cattle numbers have greatly increased. The farmer has therefore increased the carrying of the whole farm by seven-eighths of a breeding-ewe to the acre plus dry sheep and cattle.

In both quality and quantity the wool has shown a steady improvement.

EXAMPLE 3.

Farm A: Top-dressed (3 cwt. per acre on 200 acres); Farm B: Untop-dressed.

Rainfall: 60 in. annually, with between 125 and 150 rainy days.

The two properties chosen in this district are on exactly the same type of country, of almost the same area, and with the similar areas of ploughable land.

Farm A.—This property has been top-dressed fairly heavily and consistently for the last six years. Farm B has had some top-dressing, but very little. Farm A was taken up in 1926, and was then carrying 600 to 700 ewes, and the balance, making a total of 1,466, were hoggets and dry ewes. At the commencement of top-dressing in 1930, 1,000 ewes were carried, and no dry sheep except twenty or thirty killers and rams. The change-over from breeding to buying was made as soon as the property was taken over in 1926. Up to and including 1930, an average of 40 per cent. of lambs went away fat off the mothers, the balance being sold as stores. To-day, 75 per cent. of the lambs go away fat off the mothers, 60 per cent. going in the first cut, the balance being fattened on grass, no rape being grown. In addition to the lambs which are bred on the place and fattened, between 400 and 500 stores are bought in and fattened. To-day the property is carrying approximately 1,400 ewes and fattening lambs on the 682 acres. Old ewes are sold in lamb, and all cattle are sold fat.

There is also a marked difference—which, however, cannot be indicated definitely—in the way that the ewes come out of the wool: nearly every sheep shorn is prime enough for killing off the shears. Whereas lambs previously were not turned off the place until the end of December the first draft now goes away at the end of November. Ewes coming from nearly anywhere on to this place seem to do well, coming through the winter to lambing in much better condition than was the case previously. This has been so noticeable that as the result of top-dressing it has been found possible on this farm to discontinue the growing of swedes to carry ewes through the winter.

Farm B, which has not been top-dressed. This property was taken over in 1925 by the present owner, and carried, on the 625 acres, 1,100 sheep, and this number has remained approximately constant until this year, when it is again 1,100 sheep—800 breeding-ewes, 260 hoggets, 40 killers, rams, &c. The Southdown is not used at all, and wether lambs are not fattened, but are sold as stores. Old ewes at five years old and cull two-tooths are sold as breeding-ewes. If one breeding-ewe is estimated as the equivalent of two dry sheep the farm carries approximately 950 breeding-ewes. The amount of wool clipped on this place, where there is scope for the breeding and selection of well-woolled sheep, was 9·5 lb. per head. The lambing percentage is 95 to 100. It must be remembered that only the Romney ram is being used, and there is a percentage of two-tooths in the flock.

Comparison.—Farm A has increased from 1,400 sheep, 600 to 700 of which were breeding-ewes, to 1,000 ewes in 1930, when top-dressing was commenced, to 1,400 at the present time. Farm B has remained stationary at 1,100 sheep, say, equivalent to 950 breeding-ewes, since 1925.

Farm A has an average lambing percentage of 105 to 114. Farm B has an average lambing percentage of 95 to 100, one-quarter of the flock being two-tooths, and the Romney instead of the Southdown ram being used.

Farm A clipped 11·3 lb. of wool this year. Farm B clipped 9·5 lb. Farm A sells all fats ; Farm B sells all stores.

EXAMPLE 4.

Farm A : Top-dressed (1 cwt. of superphosphate per acre every other year on 200 acres) ; Farm B : Untop-dressed.

Rainfall : 35 in. to 40 in., with 125 rainy days.

Farm A.—This property is 443 acres in extent, and was taken over by the present owner in 1921, when it carried 370 sheep, 90 of which were hoggets. When top-dressing was commenced eight or nine years ago, 450 ewes and 100 ewe hoggets were being carried, and swedes and rape grown for winter and fattening feeds respectively, which meant the upkeep of a team and implements. The change-over from the policy of breeding to buying was made simultaneously with the commencement of top-dressing. To-day the property is carrying over 800 ewes Since the top-dressing of the farm the lambing percentage has increased from 85 to 110, the 85 per cent. being the average lambing obtained from the Romney flock before the change-over to the Southdown was made and top-dressing was applied. It is maintained by the owner that since top-dressing he has increased by 3 lb. the weight of wool per fleece.

The year the change-over to the Southdown ram was made only 20 per cent. of lambs went away off the mother, and this was usual up to that time. In the autumn of that year fertilizer was applied, and the following season 70 per cent. of the lambs went away off the mothers, increasing up to 90 per cent. in the following year. Since that time practically every lamb on the place goes away fat off the mother.

The wool clip averages 8 lb. to 8½ lb. per fleece. When rape was grown as a fattener, lambs never went away until February or March, but now all lambs are away before the end of January.

Farm B.—In 1922 this place carried through the winter 533 sheep on the 380 acres. The present number being carried is 674, 550 of which are ewes and 120 hoggets. There has, therefore, been an advance in total sheep numbers of 123 in the last fourteen years. The wool clipped per fleece on this property is 6 lb. to 7 lb. The lambing percentage is 80 to 85, the Romney ram being used, and there being about one-fifth of the flock two-tooths.

Comparison.—Farm A has shown an advance of 546 sheep on an original number of 370, together with a change-over to fattening, over a fifteen-year period.

Farm B over the same period has shown an advance of 123 sheep over an original 533, unaccompanied by any change to fattening.

Farm A clips 8 lb. to 8½ lb. per head off old sheep. Farm B clips 6 lb. to 7 lb. per head off a mixed flock.

Farm A has an average lambing of over 100 per cent., and lambs go away fat off the mothers. Farm B has an average lambing of 80 per cent. to 85 per cent., and no lambs are fattened.

DISCUSSION.

The field experience described above is not submitted as definite proof that top-dressing pays in all the areas mentioned above, although the figures certainly suggest that this is the case. Neither are the results described to be interpreted necessarily as a condemnation of the practice of those farmers who do not top-dress, for many farmers who took over places in high-price periods were not in the position during the slump years to spend money on fertilizers

The data presented tend to show that, as a result of top-dressing—

(1) Stock numbers, on all places quoted above as being top-dressed, have increased :

(2) In most cases this increase has been, or will be, accompanied by a change-over from the selling of the surplus stock as stores to the selling as fats :

(3) That lambing percentages tend to increase :

(4) That more wool per fleece, of a better quality, is grown :

(5) That good pastures can be maintained in places where good pastures were never maintained before.

It is rather noticeable that all places chosen were in areas with a rainfall of 35 in. or more. The results cited above were not the results of top-dressing alone , they were the results of a combination of factors of which top-dressing was one. In order that maximum results may be obtained from the application of fertilizer, the value of efficient management of pastures and stock, subdivision, and shelter must be appreciated, and, in the cases where good results have been obtained from top-dressing, these matters have received due attention

GOOSEBERRY CULTURE.

H. F. FROST, Orchard Instructor, Masterton.

THE gooseberry is probably the most extensively planted berry-fruit in the Dominion. While it does not usually bring the attractive prices realized by the other berries, the ease of production, harvesting, &c., makes it quite a profitable crop, possibly more definitely so over a period than the other berry-fruits.

Gooseberries thrive under most conditions in the cooler districts, but prefer a moderately light, well-drained loam, although they have been observed doing well under heavy-loam conditions. They do not thrive where soil acidity is present. Consequently, a fairly heavy liming is desirable prior to planting, and subsequently at intervals. It is necessary to clean the land thoroughly of weeds prior to planting, and for this purpose, after the land has been deeply ploughed or dug and worked-down, a crop of potatoes or a lupin cover crop should be grown the season before the bushes are to be planted out.

VARIETIES.

The selection of varieties is of some importance; early maturing is important, owing to the practice of marketing the major portion of the crop in the green state. Early marketing is necessary owing to the falling-off of the public demand when the raspberry and strawberry crops come forward in bulk. Of the varieties in commercial plantings, Farmers' Glory is the best and most consistent cropper. Roaring Lion is also a good variety. Of the others, Gregory, Lancashire Lad, Trumpeter, Crown Bob, Winham's Industry, and May Duke are the best known. There are a number of new varieties under test overseas, and some of these may prove to be suitable for our purposes.

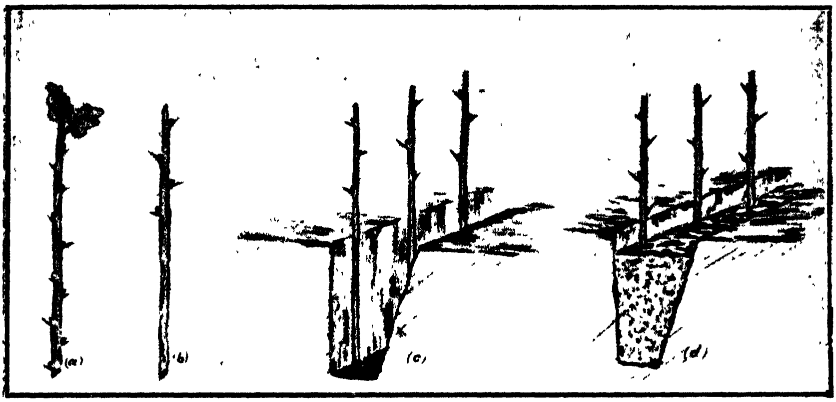

FIG. 1. (*a*) ORIGINAL CUTTING, (*b*) THE CUTTING DISBUDDED, (*c*) PLACED IN TRENCH, (*d*) WHEN FILLING TRENCH, EARTH SHOULD BE FIRMLY TRODDEN IN AT THIS STAGE.

PROPAGATION.

The usual method of propagation is by cuttings. These should be selected from the more vigorous and best-cropping bushes. They should be cut into lengths of 10 in. to 12 in.; all the lower buds should be removed, and three or four buds left at the top. The cuttings should then be placed in a selected bed of medium loam by digging a 6 in. to 8 in. trench, and then placing the cuttings a few inches apart. The soil should then be filled and trodden in firmly; it may be necessary to inspect these from time to time to see that frost action has not loosened the soil about them; if so, this should have attention, and the ground should be trodden in firmly again. During the ensuing summer the land about the cuttings should receive frequent hoeings. In the autumn plant out in prepared soil, about 1 ft. apart, and cut back the main branches to a couple of buds. Commercial growers usually use the two-year-old plants for planting out permanently.

PLANTING.

Generally speaking, 6 ft. by 6 ft. apart is considered the most suitable distance to plant. Various considerations enter into this question, such as the type of growth of the variety, the method of cultivation contemplated—viz., horse or tractor—and, perhaps the most important

of all, whether green crops are to be grown for ploughing-in purposes. Should this be intended a greater margin, say, 7 ft. by 7 ft., would be advantageous. If spade and hoe work only are to be used, the 6 ft. by 6 ft. planting will be found to be sufficient. Care should, however, be exercised when planting to see, as far as practicable, that root-injury is avoided; broken roots should be pruned back to sound healthy wood.

PRUNING.

After the first year's growth, four or five of the strongest shoots should be selected as the main branches. It is necessary to cut these back two-thirds of their growth, so that a strong, well-balanced, robust

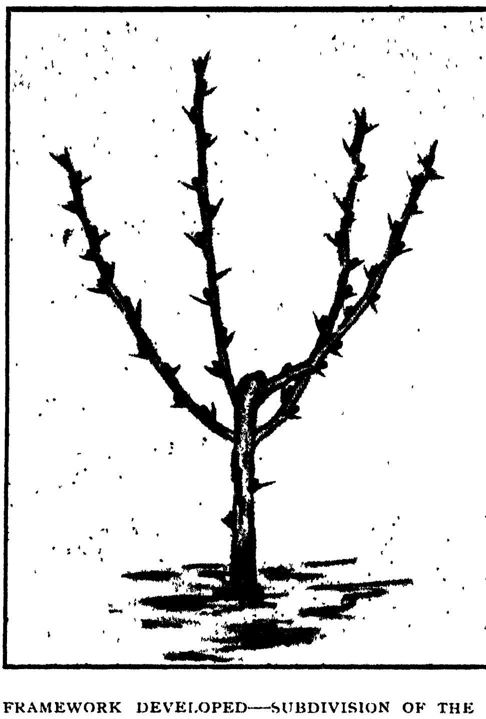

FIG 2. INITIAL FRAMEWORK DEVELOPED—SUBDIVISION OF THE LEADERS MAY BE INSTITUTED AT THIS STAGE WHERE NECESSARY.

bush may be developed. The balance of the shoots should be completely removed or cut back to encourage the development of fruiting-spurs. It must always be borne in mind that the best fruits are grown on the previous year's growth, and at subsequent pruning this aspect must be kept in view

Crowding the centre of the bush with too many leaders should be avoided. Light and air are essential. To prevent crowding the centre a system of completely heeling out superfluous shoots may be employed. This is accomplished by twisting (not cutting) out the undesirable shoot at the base. This method has the advantage of removing basal buds, and it eliminates the risk of the development of wood suckers.

The number of leaders may be increased as the size of the bush increases; these should be well furnished with spurs and fruiting-laterals. Cut back annually to keep the bush vigorous and to ensure the development of new growths, which in the following season produce the best class of fruit. Cut out all crossgrowths and rank shoots; these latter rarely produce fruit-buds.

By the time the plant settles down to annual cropping, a proportion of the leaders outlive their usefulness. Provision for their replacement should not be lost sight of by the pruner. There is a tendency for the bushes to develop a spreading habit. This may be obviated by the gradual removal of the lowest branches, and by cutting to an upright lateral or inside bud of a strong annual shoot. The chief objective in pruning operations is to keep the plants in normal vigour, and, as there is considerable variation in the response of the different varieties to treatment, both as regards cropping and growth, it is advisable to take careful note of the results of previous pruning and cultural operations. This assists in a large measure in deciding the particular future treatment most suitable for each variety.

Cultivation.

The land should be kept in good tilth, especially during the crop-development period; the conservation of moisture is all-important and to ensure this regular hoeings and shallow cultivation should be given, continuing until possible damage to crop prevents further work of this nature.

After harvesting the crop merely sufficient cultural work to keep weeds under control should be done. Excessive cultivation in the late summer is inadvisable, as it may be the means of encouraging sappy growth late in the season. The fibrous surface-roots should be injured as little as possible by digging.

Manuring.

Gooseberries readily respond to applications of farmyard and other organic manures. Owing to a general shortage of this material, green cover-crops are being used to supply that need. Mineral fertilizers applied in the spring are also extensively used with satisfactory results. The following mixture is suggested for application under average conditions: Sulphate of ammonia, ½ cwt., superphosphate, 2 cwt.; sulphate of potash, 2 cwt. per acre. The quantities and proportions of the fertilizers should be varied in accordance with the vigour of the bushes. A fact of guidance to small growers is that about 2 oz. of the above mixture to the square yard would be required. Potash appears to be one of the most important fertilizers for this crop: it should be applied annually in one or other of its forms—the sulphate form for preference.

Soil acidity is to be avoided, and any tendency in this direction should be rectified by the application of 10 cwt. of carbonate of lime per acre in the spring every two or three years. A light dressing of nitrate of soda, just at fruit-set, well repays the expenditure.

Pests and Diseases.

The gooseberry is possibly less prone to attack by fungi than the majority of the small-fruits grown in this country.

We are particularly fortunate in being free from such a disease as the "American gooseberry mildew," and also from the saw-fly (*Nematus ribesci*), both of which do very considerable damage to this plant in the Northern Hemisphere.

Botrytis causes much loss to gooseberry-growers in the Dominion. This disease is sometimes confused with root-rots. It may be detected in an early stage of its development through the wilting of the foliage on individual branches When observed these should be cut out at their base and the cut surface dressed with bitumen paint or with Bordeaux paste, which is composed of 1 lb. copper sulphate, 2 lb. hydrated lime, and 1½ gallons of water.

Should leaf-spot be of a severe nature, a spring application of Bordeaux mixture (5 lb. bluestone, 4 lb. lime, and 50 gallons of water) is desirable. This may be followed with advantage by an autumn application at the same dilution. The materials required to make a 4-gallon quantity of Bordeaux of 5-4-50 strength is as follows: Bluestone, 6½ oz.; hydrated lime, 5¼ oz.; and water, 4 gallons.

European gooseberry mildew (*Microsphaera grossulariae*) is held in check easily with a spring application of lime sulphur (poly-sulphide content 15 per cent. W/W) at the dilution of 1 part by volume to 15 parts of water, when the buds begin to swell. Later in the season, if necessary, apply lime sulphur 1-180 plus colloidal sulphur 2-100, and repeat if mildew is present.

Silver-leaf (*Stereum purpureum*) also attacks the gooseberry, and, when detected, the affected part should be cut out, and the treatment advised for botrytis applied. In the event of the disease having reached an advanced stage, it would be advisable to dig out the plant and destroy it.

A careful watch should be kept for the borer, which causes much damage if left unchecked. Its presence is easily detected through a wilting of the leaves. When observed, the affected twig should be cut out and destroyed. Control of this pest may be made more efficient by the removal of dead wood and stubs at the annual pruning, as these are the usual places about which the female deposits her eggs.

TARANAKI PASTURE COMPETITIONS, 1935-36.

A. G. ELLIOTT, Instructor in Agriculture, New Plymouth.

THE past season has been the most successful since the inauguration of the pasture classes, not only from the greatly increased scope of the competition by the provision of extra classes resulting in additional entries, but also in the focussing of attention on grassland problems as shown by the numbers of farmers who attended during judgings in each district. An indication of the increased interest taken by farmers generally is shown by the total entries, which were—1935-36, 308; 1934-35, 107; 1933-34, 115; 1932-33, 93; 1931-32, 102; 1930-31, 50.

While no district has withdrawn from the competition, five—namely, Rahotu, Cardiff, Mangaehu, Uruti, and Okau—have entered for the

first time. Of the total 308 entries, of which only three were ineligible for the second judging in autumn when they were cut for ensilage, thirty-seven were in the newly constituted improvement class and twenty-eight in the open or mixed-grazing class created this year. In connection with these new classes any entry judged the previous year, whether in the dairy or open class, is eligible for the improvement championship and the field may be harrowed and surface-sown or any form of surface cultivation may be practised, but the area must not be ploughed. Members of the Competitions Committee firmly believe that this is the most important class in the pasture section, tending as it does to bring about economical grassland improvement on every farm. The open class was inaugurated to bring in farms on which sheep are grazed either alone or with the dairy herd, and also to secure entries from farms where pigs are carried on the open-grazing system. This scheme of mixed stocking of pastures either in rotation or all on the area at once is becoming a definite practice and has much to recommend it.

Judging, which commenced in the middle of October and occupied about five weeks in the spring, was carried out exactly as last year, but it will be noticed that, as the season was backward and pastures had in many districts suffered badly from "poaching" during the winter, points were slightly lower than at the same time last year Autumn judging started in the second week of March and was completed on 9th April, when the six top dairy entries and the three top open entries were rejudged on the one day. Just as the pastures were backward in most districts for the first judging, the opposite condition prevailed in the autumn, when, owing to the unusual flush of feed, many areas showed rank growth, indicating lack of control. Competition in both dairy and open classes was very keen, and it is noteworthy that Lepperton and Okato districts practically divided championship honours, with Ngaere also showing up prominently in the list of winners. After each judging, a complete list of points awarded every entry was left in the district, and these data are not published in full.

The year under review has been a most difficult one for the grassland farmer, as, although the usual amount of winter feed was saved, it proved insufficient in many districts as the unusually cold, wet conditions necessitated heavier feeding in July. Two important lessons to be learned from the season were– firstly, that one can never have too much feed in reserve, and, secondly, that shelter is of extreme importance. The value of the former was obvious to those who were unfortunately forced to purchase hay for the late winter and early spring, when pasture-growth was slow and the effect of shelter was marked, not only in the better condition of stock on sheltered farms, but also in the earlier growth seen on such protected fields. Certain districts are now fairly well furnished with hedges and shelter-belts, but there is still much to be done in this direction throughout the territory generally.

The following data obtained from information supplied by competitors are of great interest, enabling the reader to study the methods in practice on the farms under review.

ACREAGE OF PADDOCKS.

The sizes of the fields entered were—3 acres, 34 fields; 4 acres, 51; 5 acres, 43; 6 acres, 36; 7 acres, 29; 8 acres, 21; 9 acres, 7; 10 o 15 acres, 43; 15 to 20 acres, 4.

Even with the open friable soils providing good drainage for the majority of pastures, subdivision can be overdone in this high-rainfall climate. Size of field must necessarily be governed not only by the number of stock carried but also by the ability of the farmer to feed out in such a way that winter "poaching," resulting in weed-invasion, is reduced to a minimum. Actual observation on the farms inspected shows that the rejuvenating of the badly "poached" sward entirely by reseeding from the hay fed is not achieved generally, and the deteriorated sward is invaded by weeds, adding to a problem already assuming great proportions for all grassland farmers.

AGE OF PASTURES.

The following data indicate the age of the pastures: Three to seven years, 75; seven to ten years, 21; ten to fifteen years, 52; fifteen to twenty years, 38; over twenty years, 73.

While additional areas are being sown down each year, much of the production of the territory is secured from the older and in some cases surface-sown pastures. This year all but two of the leading championship pastures were over ten years old, and this again emphasizes the fact prominent in the last pasture competition that there is room for improvement in preparation of land and seeding-down as well as in management and utilization.

TIME OF SOWING.

The time of sowing was given in only 186 cases, and of these 140 were sown in the autumn and forty-six in the spring. The latter were mainly in the southern and central districts, where frosts and cold wet conditions render autumn sowings of rather doubtful value. If farm labour could be suitably provided in these districts a February sowing might be effective under favourable weather conditions, and such sowing is well worth a trial when spring sowings are so apt to be affected by prolific weed-growth.

QUANTITY OF SEED PER ACRE.

The following quantities of seed per acre were sown in 161 of the fields entered: 30 lb. to 40 lb., 39; 40 lb to 44 lb., 33; 45 lb. to 49 lb, 47; 50 lb. to 54 lb., 25; 55 lb. to 59 lb., 4; 60 lb. to 65 lb., 13.

In connection with sowing down, one weakness still apparent and not mentioned in the report for last year is clover deficiency. The importance of thorough working to provide a firm and moist seed-bed has already been emphasized, and it is probably the lack of consolidation which results in poor clover strikes. This weakness in the young sward possibly affects the later top-dressing of the pasture, but it is obvious that if the clover can be established in the very young pasture it will be of considerable value not only in the grazing it provides but also in its effect on the grasses in the mixture

MANURE WITH THE SEED.

Of 161 entries, fifty were sown without manure. Details in regard to the balance, numbering 111, are as follows: Superphosphate, 33; superphosphate plus bonedust, 25; superphosphate plus lime, 16; blood and bone, 3; basic slag, 8; superphosphate plus slag, 4; superphosphate plus blood and bone plus potash, 2; proprietary grass manures, 20.

SUBSEQUENT TOP-DRESSING.

The following table indicates the fertilizers used in top-dressing during recent years :—

—	1935	1934.	1933.	1932.
Basic slag	27	9	17	30
Superphosphate	45	23	31	36
Lime plus superphosphate	35	22	21	19
Slag plus superphosphate	10	4	3	4
Slag plus potash	1	1	1	..
Superphosphate plus potash	9	8	4	2
Lime plus superphosphate plus potash	23	..	..	..
Phosful	12	..	..	..
Superphosphate plus Phosful	4	.	..	..
Nauru	1	..	..	..
Ammoniated superphosphate	10	2	..	.
Slag plus ammoniated superphosphate	1	..	..	..
Lime plus superphosphate plus blood and bone	2	.	..	..
Superphosphate plus blood and bone plus potash	7	.	..	..
Superphosphate plus slag plus potash	1	..	..	..
Slag plus bonedust plus potash	2	..	..	..
Lime plus potash plus ammoniated superphosphate	1	..	..	..
Proprietary grass-mixtures	53	19	9	6
No manure	8	9	7	..

In considering the above table it must be remembered that in 1935–36 there were 252 entries, compared with 107 last year, 115 in 1933–34, and so on, and consequently in comparing different years proportionate calculations should be made.

The majority of farmers still firmly believe in the outstanding value of basic slag, and in a large number of cases the manures or manurial mixtures above are the result of an endeavour to replace this imported article. This fact is borne out by the orders for basic slag for the current season, when the decreased price, together with the fact that there are more funds available for purchase of manures, has resulted in the importation of approximately 30,000 tons, as compared with roughly one-fifth of that quantity last year The continued use of basic slag is probably in part due to the clover deficiency previously mentioned, as it is generally admitted that clovers respond most economically to the more slowly acting phosphates. Obviously where grass is dominant in the sward the addition of straight superphosphate rarely affects the balance of the ingredients in the way of stimulating clovers, but usually gives increased bulk. The utilization of this flush of feed has in most cases been incomplete, and has resulted in a prejudice against the more quickly acting phosphate, and has also a tendency to make users return to the slowly available one with whose effects they are familiar. Again, in seeking to replace basic slag, the nearest and most economical substitute would either be a mixture of lime plus superphosphate or else early liming followed by straight superphosphate. While the marked increase in importation of basic slag indicates the farmers' preference, there are a number of very successful farmers who have evolved a mixture suitable for their country, and in each of these superphosphate figures usually with lime and potash. It is also of interest to note the efforts made by fertilizer firms whose mixtures usually contain lime and superphosphate with potash and some nitrogenous fertilizer. Such proprietary

mixtures were applied on fifty-three fields entered, and this is a considerable increase proportionately compared with the figures of last year. Possibly the basic slag now being applied will effect improvement in pasture production, but it has not yet proved itself to be generally more economical or capable of giving greater increases in production on well-managed pastures in good heart than other mixtures of equal cost. One of the outstanding pastures this season is one where no basic slag has been used for some years, and the sward is maintained in good heart by following the practice of rotational grazing and applications twice a year of lime, superphosphate, and 30 per cent. potash.

Many of the entries judged have been top-dressed with shed washings, and this is definitely a payable practice limited only by the contour of the farm. The total cost of the whole outfit, including pump, 200-gallon tank, sledge, and 500-gallon sump, is under £30, while maintenance costs are low. Particularly where the sump can be established to allow gravity feed into the tank, the labour is light and more than repays the outlay and additional work involved. This method of returning valuable ingredients to the pasture is invaluable, and it is encouraging to see the increase in number of plants now operating with excellent results.

Quantity of Artificial Fertilizer Used.

The quantity of fertilizer applied was—

——	1935.	1934.	1933	1932.
2 cwt per acre	6	4	3	3
3 cwt. per acre	195	76	82	84
4 cwt. per acre	27	12	13	17
5 cwt. per acre	13	6	2	3
Over 5 cwt. per acre	11	..	..	..

The proportion of those applying 3 cwt. per acre has increased slightly since last year, but the greatest improvement is in the number top-dressing at the heavier rates, and this usually involves two applications, one in the summer and the other in the early spring. It is not sufficient to apply 3 cwt. per acre of fertilizer and then expect all weeds to disappear and good grasses and clovers to take their place. Many areas top-dressed give doubtful returns for the money spent, and, particularly at this time when production-per-acre is all important, a close study of the sward before deciding on the top-dressing programme is a matter of necessity. This season has been a good one for surface-sowing of seed, and the results already noted indicate that this method of rejuvenating the deteriorated sward is sound practice and gives a pasture which will give payable returns from top-dressing since the newly established good constituents give highly nutritious feed, and the whole field so treated need not be shut up for very long.

Types of Harrows.

Harrowing of pastures generally is a highly controversial matter, not so much as to whether it should be done or not, but more particularly in regard to the type of implement to be employed.

More than half of the makes used are of the lighter types which spread droppings and remove roughage, but adherents of the "drastic" practice are firmly convinced that the results they obtain definitely are payable. It will be conceded generally that where undesirable plants such as blackberry, gorse, and possibly also pennyroyal, are to be eradicated the heavier types of harrows are to be preferred to the lighter makes. Where a sod-bound turf occurs, and this in the territory under review usually is encountered only where paspalum is dominant, the heavier harrow should be employed; but general pasture experience has not yet shown the value of root-pruning and soil-aeration. Where weed-growth is so prolific as in North Taranaki the tendency is for the spaces left after drastic harrowing to be rapidly occupied by weeds and weed grasses. Consequently it seems that this severe harrowing should be followed by surface-sowing, and this harrowing, which is really a form of pasture cultivation, will probably become standard practice for rejuvenating deteriorated pastures where root crops are not grown or where the area in sown grasses does not allow the shutting-up of the particular field for a long period.

The following table shows the number of strokes of harrows given to the various entries: 1 stroke, 79; 2 strokes, 91; 3 strokes, 19; 4 strokes, 19; 5 strokes, 8; 6 strokes, 11; 7 strokes, 1; no harrowing, 34.

CARRYING-CAPACITY.

The carrying-capacity (expressed in acres required for one cow) of the entries in the dairy class, grouped according to size of farm, were: Up to 50 acres, 1·79; 51 to 75 acres, 1·95; 76 to 100 acres, 2·00, 101 to 150 acres, 2·14; over 151 acres, 2·28.

The champion pasture for the season was the No. 1 entry in the dairy class of Mr J N Blyde, Lepperton, which was awarded 182½ points, the field being 3½ acres in area and over twenty years old. This paddock has shown steady improvement as indicated by the fact that in competitions it has been ninth, sixth, fourth, and second, and this year secured highest honours in the North Taranaki Championship. Areas on this farm were top-dressed twice a year as follows: 1932—2½ cwt. superphosphate in spring, plus 3 cwt Calciphos in winter; 1933—2½ cwt. superphosphate plus 1½ cwt 30-per-cent. potash in spring, plus 5 cwt. lime, 2½ cwt superphosphate, and 2 cwt 30-per-cent potash in winter; 1934—2 cwt superphosphate and 1¼ cwt. 30-per-cent. potash in spring, and 4 cwt. lime, 2½ cwt. superphosphate, and 1½ cwt. 30-per-cent. potash in winter; 1935—2½ cwt superphosphate and 1¼ cwt. 30-per-cent. potash in spring, with 4 cwt. lime, 2½ cwt. superphosphate, and 1¼ cwt. 30-per-cent potash in winter. The sward is dominant rye-grass, white clover, timothy, and cocksfoot, and is very even throughout, while it was harrowed twice during the season, received four applications of shed washings, and was topped once between spring and autumn judgings. The standard of pasture and pasture-management on this farm is shown in the fact that a return of 340 lb. butterfat per acre for the season is anticipated.

Mr. R. Cassie, Okato, secured second place with a 5-acre field three years old, sown in the spring with 40 lb. of seed per acre, 3 cwt. per acre superphosphate and bonedust being applied at sowing. This entry was in very good heart, and was awarded 182 points in the open championship in the dairy class. In 1934 it was top-dressed with 2 cwt.

per acre of Phosful, and last year received 2 cwt. Phosful in the autumn followed by 2 cwt. ammoniated superphosphate in the spring. The sward was remarkably even and well balanced, being dominantly rye-grass, cocksfoot, and white clover, with very little weeds present.

Mr. W. F. Goodin, Okato, was third with a field of 17 acres, twelve years old, sown in the autumn with 60 lb. seed per acre, while in 1933 it was top-dressed with basic slag, in 1934 with guano, and last season again with slag, all at 3 cwt. per acre. It was harrowed four times during the year with chain and tines and was very even throughout.

In the open-grazing class for mixed stock first place was secured by K. W. Jackson, Ngaere, with a six-year-old field of 4 acres sown in the autumn with 45 lb. seed per acre. The area is well sheltered and is dominantly rye-grass, cocksfoot, and white clover, giving a dense sward largely grazed by pigs. It was top-dressed in 1933 with African phosphate 3½ cwt. per acre, in 1934 with lime 7 cwt. plus superphosphate 4 cwt. per acre, and last year with 3½ cwt. per acre of proprietary mixture. The field was harrowed twice with a tripod, and was remarkably free from weeds, indicating the value of mixed grazing in this connection.

Messrs. J. Cloke, Lepperton, and W. J. Bridgeman, Okato, tied for second place in this class, each receiving 180½ points.

The Lepperton entry was eighteen years old and 5 acres in area, being grazed with dairy cows and sheep. In 1933 it was top-dressed with basic slag, 4 cwt. per acre, in 1934 with blood and bone, 4 cwt., and last year with lime, superphosphate, and potash, 4 cwt. per acre, while it was drastically harrowed three times during the season.

The entry at Okato was thirteen years old and 4½ acres in area, sown in the autumn with 48 lb. seed per acre, 3 cwt. bonedust, superphosphate, and lime being applied at sowing. In 1933 it was top-dressed with 3 cwt. ammoniated superphosphate in the spring, followed by 3 cwt. superphosphate in the autumn, in 1934 with 3 cwt. lime, superphosphate, and bonedust, and last year with 3 cwt. lime and superphosphate. It is grazed by pigs and sheep and was harrowed once with the tripod.

In the improvement class the winner was Mr. B. J. Fabish, of Inglewood, whose entry showed considerable thickening-up of the sward and introduction of better pasture constituents.

Mr. B. Dixon, Tarurutangi, was second, and in this case greater consolidation and spreading of droppings after stock concentration was one of the main reasons for improvement. Stimulation of rye-grass was the outstanding feature of the pasture, together with a general thickening-up of the whole sward.

Mr. L. F. Bishop, Tarurutangi, secured third place with an entry which has shown steady improvement during the last few years, and owes its position to-day to a considerable increase in the proportion of good grasses and also to improved bottom growth generally.

NORTH ISLAND LAMBING ESTIMATE.

From information supplied by Inspectors of Stock in the various districts, the average lambing for the current season in the North Island is estimated at 90·5 per cent., compared with 83·68 per cent. in 1935. With 10,300,826 breeding-ewes in the North Island, as shown in the 1936 sheep returns, the number of lambs this season is estimated at 9,322,476. South Island and Dominion returns will be given in next month's issue of the *Journal*.

WHEAT VARIETIES, HARVEST OF 1936.

THE figures appearing in the following table were compiled from monthly returns furnished by proprietors of threshing-machines up to 26th September, 1936. The area accounted for in this manner was 217,904 acres, out of a total area of 248,639 acres of wheat threshed, according to the annual collection of agricultural and pastoral statistics carried out by the police on behalf of the Census and Statistics Office.

Variety of Wheat threshed.	Area threshed.	Total Yield.	Average Yield per Acre.	Percentage of Total Area.	Percentage of Total Yield.
Tuscan—	Acres.	Bushels.	Bushels.		
Solid-straw Tuscan ..	150,980	5,768,816	38·21	69·29	68·67
Dreadnought ..	6,692	283,488	42·36	3·07	3·37
"Cross 7"	1,368	61,744	45·13	0·63	0·73
Montana King ..	905	33,595	37·12	0·42	0·40
Hollow-straw Tuscan ..	594	23,722	39·94	0·27	0·28
Solid-straw Velvet ..	590	26,199	44·41	0·27	0·31
Sensation	326	13,095	40·17	0·15	0·16
Red Marvel	110	2,247	20·43	0·05	0·03
Victor	98	4,609	47·03	0·04	0·05
Bencubbin	97	2,633	27·14	0·04	0·03
Other Tuscan varieties	173	7,141	41·28	0·08	0·09
Totals	161,933	6,227,289	38·46	74·31	74·12
Hunters—					
Hunters	33,478	1,413,510	42·22	15·36	16·83
Major	1,317	34,363	26·09	0·61	0·41
Federation	933	31,735	34·01	0·43	0·38
Yeoman	155	5,161	33·30	0·07	0·06
Totals	35,883	1,484,769	41·38	16·47	17·68
Pearl-					
Jumbuck .. .	14,676	500,901	34·13	6·74	5·96
Pearl and Velvet ..	2,293	80,387	35·06	1·05	0·96
Garnet	749	21,045	28·10	0·34	0·25
Marquis	2,370	86,805	36·63	1·09	1·03
Totals	20,088	689,138	34·31	9·22	8·20
Totals, all varieties	217,904	8,401,196	38·55	100·00	100·00

Due to differences in soil types, localities, times of sowing, and climatic conditions, all of which influence the choice of wheat varieties sown the yield-per-acre statistics cannot be regarded as the sole criterion of the relative fruitfulness or desirability of the individual types Again, other factors—*e g*, quality of wheat, resistance to wind, adaptability to humid conditions, &c—have to be taken into account.

—*Monthly Abstract of Statistics.*

CHECKING QUALITY OF FERTILIZERS.

THE Department of Agriculture is desirous of the assistance of farmers in checking the quality of fertilizers on the market, and farmers are urged to send forward samples for analysis No fee is charged for this work, and in the event of any deficiency being found an official sample of the fertilizer will be taken from the vendor's store by an Inspector under the Fertilizers Act This will enable the Department to decide whether legal proceedings should be taken if discrepancies occur.

In connection with samples of this nature, a portion of the fertilizer should be taken from each of a number of bags, and the portions thoroughly mixed together. Finally, an amount weighing about 1 lb to 2 lb may be put into a clean, dry tin or jar, and forwarded with the invoice certificate (or a copy of it) addressed to the Inspector of Fertilizers, Department of Agriculture, Private Bag, Wellington, C. 1. It is important that the invoice certificate should accompany any sample sent, or, if no certificate has been supplied, the name and address of the vendor and the brand of fertilizer should be given.

SEASONAL NOTES.

THE FARM.

Sowing of Arable Crops.

OF the crops customarily sown at this season, the swede is an important crop which temporarily at least has gone out of favour to some extent in certain districts, partly because of the serious ravages of insect pests. In this connection it is to be noted that the prospects of controlling the ravages of the white butterfly, which attracted so much attention, now seem good. Over wide areas good results are obtained consistently from season to season by sowing swedes in December at a date which enables the seedlings to escape the main flight of the beetles of the grass-grub. The brown beetle (the adult stage of the grass-grub) is responsible for much, if not all, of the insect activities attributed to the "turnip-fly," and so, unless guarded against, is a serious obstacle to successful growing of swedes and soft turnips. The beetle eats only those portions of plants which are above ground, and hence the effect is greatest on plants which are in the seedling-leaf stage, for, in the case of such plants, both leaves and stalk may be removed and the plants thereby destroyed, the removal of an equal amount of more advanced plants may be followed by a setback, but also by eventual recovery. Normally the beetle either destroys a crop wholly or destroys patches of it completely, leaving other patches relatively unharmed, so that it does not suffice to employ heavier amounts of seed The main damage is likely to take place between the first week in November and the first week in December, but it varies to some extent from year to year, and probably also from district to district. Successful results may be expected from sowing swedes at the rate of 10 oz. to 14 oz. an acre through every second coulter of an ordinary grain-drill, but sowing the same quantity of seed through every coulter has also given good results, and, especially in the South Island, sowing on ridges 26 in. apart at the rate of 12 oz to 16 oz. of seed an acre, followed by intertillage, is widely practised, and consistently gives heavy yields. A fine firm seed-bed favours a good "strike" of swedes. A practice which continues popular in districts of good rainfall is the application of 2 cwt. to 3 cwt an acre of manure of which phosphate is the dominant constituent, while in districts of relatively low rainfall 1 cwt. to 1½ cwt. an acre of such manure is favoured. When the seed is mixed with manure for sowing, injury to the seeds through bringing them in contact even for a short time with soluble manures, such as superphosphate, sulphate of ammonia, and potash salts, should be avoided. The injury caused by superphosphate can be eliminated by mixing the superphosphate with an equal weight of ground limestone (carbonate) about a week before sowing The mixture usually sets hard, and so should not be bagged until it has been made two or three days, when it may be pulverized easily in the heap. Farmers' field competitions indicate that in northern districts Superlative Grandmaster and Majestic, and in Southland Elephant and Masterpiece, are widely used. This choice of varieties by farmers is in general agreement with the results of work relative to varieties carried out by the Department.

It should be kept in mind that seed of soft turnips and rape are subject to injury similar to that caused to swede-seed by soluble manures. Turnips commonly are sown in 7 in. drills at the rate of 12 oz. to 14 oz. of seed an acre, in 14 in. drills at the rate of 8 oz. to 14 oz., and in 26 in. drills with subsequent thinning at the rate of 8 oz. to 14 oz. an acre. Rape commonly is sown at the rate of 2 lb. to 3 lb. an acre. As a rule both of these crops

respond profitably to a dressing of artificial fertilizer in which superphosphate is the dominant constituent. The amount of fertilizer that should be used varies with the actual fertility of the soil and the rainfall during the growing-season of the crop ; seldom should it be less than 1 cwt. an acre, and on somewhat poor soils in districts of good rainfall a considerably heavier dressing may prove profitable.

One of the matters which militate against the more extensive use of cruciferous crops except chou moellier—*e.g.*, swedes, turnips, and rape—has been club-root. Field investigation shows that the damage by club-root is intensified by the use of superphosphate, whereas it is lessened by the use of lime and of basic slag. Hence, superphosphate alone should not be used with these crops when an attack of club-root is considered possible. The danger of club-root may also be countered to some extent at least by the use of resistant varieties, such as Wilhelmsberger swede.

Maize and millet to provide green feed usually may be sown successfully in December. Almost always these crops give a profitable result from an application of 1 cwt. to 2 cwt. an acre of superphosphate, and unless the soil is highly fertile it generally is profitable to supplement the phosphatic material with nitrogenous fertilizer, such as blood and bone and sulphate of ammonia. Good results have followed the sowing of maize broadcast at the rate of 75 lb to 100 lb an acre and covering the seed by a shallow ploughing, while disking has been employed satisfactorily as an alternative to such ploughing. Early Butler, Ninety-day, and Yellow Horsetooth are favoured varieties. A sowing of 15 lb to 20 lb. an acre of millet is standard practice, and, although considerably heavier sowings are sometimes recommended, definite evidence in support of them on seed-beds which have been satisfactorily prepared seems not to be available, or at least has not been noted

Generally, the best results are obtained by sowing lucerne in the latter part of November or in December A fine, firm seed-bed is essential for best results in establishment, and rapid vigorous establishment contributes greatly to subsequent good results It is good practice to sow through every coulter of the grain-drill from 12 lb to 18 lb an acre of seed , a greater quantity of seed is advisable when the seed-bed has been prepared somewhat poorly. Broadcasting and covering of the seed by light harrowing is an alternative practice, usually not quite as satisfactory as drilling Generally lime may be applied with profit before the final cultivation preceding seed-sowing Many of the past complete or partial failures with lucerne are now known to have been due to the absence from the soil of particular organisms with which lucerne collaborates in an important manner essential to its thrifty development There is no way which could be used by farmers of discovering, before growing the crop, whether the soil is inhabited by sufficient numbers of these organisms. Hence although the organism is present in some soils in ample supply for full success with lucerne, yet the safest course is to supply the organisms artificially This is termed inoculation, and the supplies of the necessary organism, which are called cultures, are obtainable from the Department of Agriculture at a cost of approximately 1s. for the treatment of the seed for an acre Suitable treatment of the seed with cultures may be nullified subsequently by bringing the seed into contact with soluble fertilizers, such as superphosphate, sulphate of ammonia, nitrate of soda, kainit, and other potash salts. When it is desired to sow seed and fertilizer together this may be done safely by using an insoluble manure, such as basic slag, or by sowing the seed with superphosphate and carbonate of lime mixed in equal proportions for about a week before bringing the seed in contact with the mixture. Much information about the establishment and general management of lucerne is given in Bulletin No. 155, which is obtainable free of cost from any office of the Department of Agriculture.

Chou moellier for winter use may be sown towards the end of November or in early December. Chou moellier at times is of special value because of its marked resistance to club-root. It is of good feeding-value; it calls for relatively little labour both during its growth and in feeding it to stock; under reasonably good conditions it consistently gives crops of quite satisfactory yield. It is preferred instead of swedes where the winter-feeding conditions are expected to be so wet that undue wastage of the swedes would occur through the trampling of the roots into the mud, but good crops of chou moellier are not obtained on soils which are water-logged during the growing-period.

Intertillage and Thinning.

Often in December intertillage and thinning of crops sown in October and November should be carried out. Usually the thinning may be carried out more easily as the result of prior hoeing along the rows. Thinning is most valuable if done as soon as the seedlings are large enough to be handled without undue difficulty. Weeding carried out at the same time as such early thinning results in the destruction of weed seedlings at a very vulnerable stage. In thinning mangels the soil should be drawn away from the plants rather than hoed up to them. The value of the cultivation which produces a good seed-bed seems to be well known, although the knowledge is not always applied, but the value of cultivation after the sowing of the seed seems not to be so generally recognized. This type of cultivation is of special current importance first of all because of its great value in the control of weeds, and apart altogether from this is the fact that a growing crop in badly cultivated ground does not obtain the full benefit from money spent on good seeds and the liberal use of suitable fertilizers. Hence intertillage of growing crops sown in rows wide enough apart to allow of it is as a rule highly desirable even though weeds are not prominent. This is especially so in the drier districts. In brief, inadequate cultivation is one of the commonest and greatest causes of unnecessarily and unprofitably low crop-yields.

Utilization of Surplus Growth of Pastures.

At this season a task of major importance lies in using to the best advantage the surplus growth of pastures. Three facts govern the position: if the surplus growth is not properly managed there is great danger of a serious decline in the quality of the whole feed-supply available from pastures; the amounts of hay and silage usually made from surplus growth of pastures are less than could be fed, with economic results, to the stock being carried; and yet, as a rule, only portion of the surplus feed available is converted into hay or silage. At times this position may be justified by the circumstances, but frequently it cannot be justified, especially on dairy-farms, but often also on sheep-farms.

The Quality of Hay.

Much of the hay saved is of decidedly poor quality, this is not always the fault of those carrying out the haymaking. Indeed, often it is the result of climatic conditions over which they have no control—a fact which points to the desirability of increased ensilage, especially in dairying districts in which the summer weather often is uncertain. Two matters which greatly influence the quality of hay are the time of cutting and the amount of rain which falls on the mown material.

The right time to cut is when the majority of the plants in the herbage have just passed the bloom stage—*i.e.*, when they have just scattered their pollen. If the crop is cut later the hay will be undesirably woody and stemmy, relatively indigestible and unpalatable, and of such poorer nutritive value than if cut at the bloom stage that any increase in the weight of the crop, which is not always to be noted, is more than counterbalanced by the falling-off in feeding-value. On the other hand, if the crop is cut earlier

the yield is less, and, moreover, the leaves are so tender and succulent that they are difficult to dry and are apt to be broken off in the haymaking. During broken or bad weather, if ensilage is impracticable, it is better, however, to allow the crop to stand than to cut it and incur the great loss that may be caused by weathering.

It is highly advisable to cut no more hay then can be handled conveniently by the equipment and staff available should rain be expected. Rain falling on cut herbage washes away large amounts of the soluble constituents, and dampness may lead to fermentation, which brings about a further loss of nutritive matter. Sometimes as much as one-third of the weight of the crop is lost in this manner, and this loss represents more than one-third of the feeding-value of the crop, for the loss is confined almost wholly to the most digestible and most valuable part of the crop. If adverse weather occurs immediately after mowing, the cut material should not be handled until fine weather seems to have returned: handling of mown material increases the readiness with which nutriment is washed out by rain. The farmer should use implements which cause the minimum damage to the crop, and in this respect it is to be noted that though the tedder is more effective in its drying action it is more damaging than the swath-turner, and is very prone to break off brittle leaves, especially those of clovers.

If the crop is light and the weather favourable practically no " making " is necessary, but generally efficient haymaking is not such a simple practice. It is questionable whether in the principal haymaking districts a heavy crop of hay can be saved in good condition without cocking, and it certainly may be said that cocking should be more widely practised. Cocking is the ideal method of obtaining hay of the best possible quality when the weather is somewhat adverse. Cocking is of great value in the saving of lucerne and of clover hay of good quality. The leaves of clover and lucerne, which are much superior in nutritive value to the stalks, readily dry and shrivel as the result of being left in the swath during bright, sunny weather, and when the hay is raked they crumble and are lost. Cocks, unless well made, are likely to be harmful rather than useful. A well-made cock is well hearted and raked and capable of shedding much rain, whereas a poorly-made cock is merely a heap which readily becomes sodden when subjected to rain. If bad weather is expected, cocking should be hastened, for the amount of washing-out of nutritive matter by rain is much greater when the herbage is in the swath.

The best time to mow lucerne cannot be determined always by the flowering development. Safer guidance is provided in the development of basal shoots; when fresh shoots at the bases or crowns of the plants are about 1 in. long the lucerne should be mown.

Means to Improvement in Ensilage.

In many instances ensilage is wasteful because it leads to avoidable loss in nutritive value. The common faults in practice that lead to such loss may be indicated briefly as—

(1) Too late cutting of the crop, which results in unduly stemmy silage, with which are associated all the undesirable features of over-mature pasture-growth. Silage is as a rule somewhat inferior in feeding-value to the green material from which it is made, hence if one starts with stemmy material of low digestibility, low content of mineral matter, and poor balance of nutritive constituents, the resultant silage is of similar nutritive character Further, late cutting gives less likelihood of a heavy leafy aftermath, which often is of great value during late summer, when leafy feed is likely to be in inadequate supply.

(2) Insufficient consolidation of the green material in pits and trenches: This results in avoidable wastage due to decay at the sides. In practice, the green material is almost never over-consolidated. The more stemmy the material the greater the need for thorough consolidation of the green material.

(3) Excessive temperatures, which are indicated by the production of dark-brown or almost black silage instead of greenish to light-brown silage. The latter, when made from the same sort of green material, possesses greater feeding-value unless a substantial amount of nutriment has been lost by the escape of liquid from the silage ; the amount of liquid that escapes from silage largely governs the loss of nutriment, and depends chiefly upon the amount of water in the green material. Hence loss in this respect is greatest from luscious material or from material harvested in wet weather. High temperatures affect adversely the feeding-value of silage, because they are associated with a greater loss by combustion than takes place at lower temperatures and a falling-off in the digestibility of the remaining material.

(4) Insufficient or delayed covering of the stored silage with material of enough weight to eliminate avoidable surface wastage by excluding the air as far as possible. The earth or other covering material should be placed on the silage practically as soon as the carting in is finished. Special care is needed to have the sides sufficiently compressed by bringing the weighting material right out to the edge of stacks

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THE ORCHARD.

Cultivation.

THE maintenance of a good tilth by frequent cultivation should on no account be neglected. Good cultivation not only maintains soil aeration, but helps to retain moisture and generally provides conditions suitable for maximum crops and tree-growth When each implement used for cultivation is finished with for the season, it should be placed in a dry shed in readiness for use when again required The plough or any implements with a bright surface should be thoroughly greased so as to prevent rusting during the period they are not in use This precaution incidentally saves considerable time and annoyance when such implements are again brought into use. An easy way to minimize rusting is to rub waste engine-oil over such surfaces as mould-board, &c.

Fireblight.

As the blossoming is practically over, the period for a general infection has now passed. However, the danger of local infection will be present if sucking and chewing insects are not controlled. Fireblight is much more virulent on quince and pear than on apple trees Branch canker on the latter is not usual, infection being confined more to the blossoms and laterals. On pear-trees, however, the organism spreads very rapidly to the larger limbs, and when this occurs there is little or no hope of saving the tree. Therefore, it is recommended that such infected trees be taken out by the roots and destroyed by fire at the earliest possible moment.

Control of Pests and Diseases.

Spraying operations recommended in these notes for September and October last should be continued for the control of pear-scab, black-spot, powdery mildew, codling moth, leaf-roller caterpillar, red mite, &c., on pome-fruit trees, and for the control of brown-rot, aphis, leaf-rust, shot-hole fungus, &c., on stone-fruit trees. Apples and pears should be sprayed with lime-sulphur (polysulphide content 15 per cent. 1–180) for the control of black-spot and powdery mildew (this is also beneficial in controlling red mite) plus arsenate of lead (powder) 1½ lb. to 100 gallons for control of codling moth. On the more tender varieties of apples, such as Cox's

Orange and Sturmer, and weakly trees, it is recommended when combining arsenate of lead and lime-sulphur mixture to add 3 lb. hydrated lime to every 1½ lb. arsenate of lead used to prevent scorching of foliage and russeting of the fruit. From the time these notes are published, applications should be made at intervals of fourteen to twenty-one days, providing the weather conditions continue to remain dry. In those localities, however, subject to fogs, heavy dews, or misty rain, the period between the spray applications should be reduced accordingly. If a high pressure is maintained a good coverage of all tree-parts is more readily obtained. Varieties of apple-trees that are subject to attack by powdery mildew should be examined at least twice during the growing-period, and, as far as practicable, infected shoots cut out and destroyed by burning. This practice is essential in certain localities for the satisfactory control of the disease.

Grafts.

All trees that have been grafted during the present season should be examined frequently. Where good growth has been made (and the scions not fastened in by tingles) the binding can now be cut. This is best done by drawing a sharp knife from top to bottom of the binding and as far distant from the scion as possible. It is not necessary, or even advisable, to further remove the binding, which is still affording the union a certain amount of protection. Shoot-growth from the stock should not be allowed to overcrowd the scion, and should be checked periodically by pinching back.

—*B. G. Goodwin, Orchard Instructor, Christchurch.*

Citrus Culture.

The October notes dealt with some of the principal diseases which are active in the spring. According to district and climatic conditions the time of the initial development of these diseases varies considerably, and it is unlikely that all matters requiring attention can be dealt with exactly to schedule, so that what was written for October applies generally for November.

Bark blotch, for instance, is a disease which requires attention over several months of the growing-season. In a grove where it is prevalent more than one inspection will be necessary, as new outbreaks are likely to occur from time to time. Diseased tissues should not be scattered about, but gathered up and destroyed. Infected chips of wood are a source of contamination, and if left about they may be the cause of additional outbreaks of the disease.

Black scale (Saissetia oleae): There appears to be considerable misunderstanding among citrus growers as to the correct naming of this pest, which is very frequently referred to as the "brown" scale. Another scale (*Chrysomphalus rossi*), which is quite large and very flat, appears on oranges and elæagnus and is often referred to as the "black scale", it is also known as the "native" scale. It is important that scales should be given their correct names, otherwise confusion may occur when control measures are being discussed. No doubt the reason why the black scale is so often referred to as brown is because only at a very late stage in its life cycle can it be said to be black in colour, and until that stage is reached it is certainly brown.

There is also to be found on lemons a brown scale (*Saissetia hemispherica*) about the same size as the black, and a large brown one (*Lecanium*).

The black scale can be recognized quite easily owing to the fact that the markings on its back form a distinct letter "H," while the brown scale is quite smooth and does not show the raised markings. The honey-dew exuded by *Saissetia oleae* is the principal cause of the appearance of the black, sooty mould often seen on citrus fruit and foliage. The mould itself (*Capnodium citricolum*) is a saprophyte—that is, it lives on dead matter,

and also the honey-dew exuded by the scale. Although it is present in many groves, the black scale does not appear to affect to any great extent the vitality of the trees which it attacks. The steel-blue ladybird (*Orchus chalybus*), wherever present, maintains reasonable control over this pest, which does not affect the fruit, but confines its activities to foliage and wood. In cases where the scale is not being satisfactorily parasitized, a summer-oil application at 1–100, applied while the young scales are emerging freely, should be effective. The black scale generally passes the winter in the egg-stage, the large adult scales being full of minute white eggs, which hatch in late spring or early summer.

Verrucosis : In some localities the trees may now be just reaching the "fruit-set" stage, so that the application of Bordeaux 3–4–50, plus summer oil 1–100, should be made forthwith. The oil, besides acting as a spreader, is useful where young black scales have hatched. While one Bordeaux spray correctly timed is generally sufficient for the clean orchard, it is unlikely to be adequate for groves which have had a bad infection of the disease. The owner of such trees must realize that, for the first season at least, considerable extra effort will have to be expended. Verrucosis infection takes place when the fruit is very small, so that the protective covering of Bordeaux must go on as soon as possible after fruit-formation—that is, at blossom fall. Where the blossoming extends—as it often does—over a long period, or where it is irregular in the orchard, it would be advisable, in the cases mentioned, to apply an additional Bordeaux so that late-formed fruit may also be protected.

Frequently at this time of the year dead laterals showing white woolly-like fructifications are to be found on citrus trees. This condition is due to the fungus *Sclerotinia sclerotiorum*, an organism which not infrequently attacks laterals injured by frost.

Cultivation : During the month cultivation should be continued. In the case of heavy clay land it may still be necessary to do a certain amount of clod-crushing and working the soil to a fine tilth, while in light sandy soils all that will be necessary will be a light harrowing. On this latter class of land there has been, perhaps, a tendency for some growers to overdo cultivation, particularly where it has been the practice to work deeply. It should be remembered that the sandy soil is generally deficient in humus, and that by constantly turning it over and bringing fresh soil up to the sun the humus is likely to be burned or dried out. It is desirable that it should remain in a moist condition to ensure maximum bacterial activity. During the next three months, provided normal weather conditions prevail, the points to be kept in mind in connection with cultivation are the prevention of weed-growth, the conservation of moisture, and the maintenance of a condition of the soil suitable for the activity of the beneficial bacteria.

Young Trees: These should receive attention regularly. Cultivation should be done carefully. If couch or deep-rooted weeds appear, these should be removed gently, as often they are entwined with the roots of the tree, and if pulled up roughly the young tree suffers damage. Growth, particularly on oranges, is slow to develop, and for the first year it should be the aim to retain as much as possible, provided that it is suitably placed. Shoots which come from below the bud union or on the trunk below the head of the tree should be removed. A close watch must be kept for the appearance of insect pests. Attacks of black aphis, leaf-roller caterpillar, or leaf-eating weevils should be dealt with on the young trees to prevent the development of the tree being retarded through this cause.

Pruning: If not already done, the work of cutting out wood which has been killed by frost, borer, &c., should not be postponed, as there are quite a number of diseases which gain an entrance to the tissues through dead or weak wood.

Picking: During the past few months some growers have refrained from picking in order to fulfil contracts for the supply of large-sized lemons

for the manufacture of peel. With the setting of the new crop, however, an effort should be made to relieve the trees of the over-size fruit so that the normal development of the young crop may not be retarded.

Budding: The present month is one of the most suitable in which to do this work, as the sap should now be moving freely—an essential condition for success.

—*A. R. Grainger, Orchard Instructor, Tauranga.*

POULTRY-KEEPING.

ONE of the difficult problems facing many poultry-keepers during the next few months is to find adequate accommodation for all their birds. Artificial incubation and brooding methods have been so much improved of recent years, and are so much better understood by many, that one has heard it said that young stock are almost too easily obtained. The great danger of modern massed production is the tendency to over-stock. Though poultry is one of the most healthy of live-stock when bred and reared under suitable conditions, there are unfortunately reports to hand from overseas and sufficient evidence in this country to indicate that poultry-keepers must ever be on the watch and guard against disease threatening their industry.

Some years ago when a greater proportion of chickens were reared in the natural way with hens, and when those who reared artificially never thought of placing more than fifty chickens in a brooder, less was heard of disease and mortality amongst poultry flocks

Environment.

Just how a flock of pullets turn out during their adult stage is as much a result of the opportunities given to them to develop properly during their growing-period as to their pedigree; in other words, environment plays a very important part regarding the stamina and vitality they may possess for their adult function

While it is fully realized that environment cannot make up for a lack of judgment in the selecting of breeding-stock, at the same time young stock from the very best of parents cannot be expected to stand up to a long laying-season and prove good breeders if conditions during their early life are such that their vitality is lowered or their development checked at any one period.

Culling of Young Stock.

To be profitable, birds must have a good constitution, vitality, and a great power of endurance. However, no matter how well-bred and carefully handled a flock of pullets has been, there is usually a proportion that do not do as well as the majority, and some that will never turn out profit-makers. To a large extent success in poultry-keeping depends upon the ability and courage of the poultry-keeper to be able to pick out and get rid of such birds before they have cost him too much. Quite a few of the less experienced poultry-keepers and many beginners seem to fail to realize the great importance of culling young stock, with the result that many late, weedy pullets that will never be profitable and are only a source of danger on a plant are kept simply because they are pullets.

Slow growth and poor feathering are indications of weakness, and such birds, together with all weakly and deformed stock, should be culled, for it is a waste of time and money to try to rear birds of poor constitution. As previously mentioned, such birds are a source of danger on any plant, as they often start an outbreak of colds and roup, which are easily contracted owing to their poor constitution and lowered vitality and their susceptibility to such troubles.

The Surplus Cockerels.

By getting rid of all surplus cockerels as soon as they are large enough, more room will be available for the developing pullets. If a certain number of cockerels is to be kept for breeding purposes, it is advisable to mark those that grow well into plump, full-chested, weighty birds, possessing masculine characteristics. While the good breeding cockerel should have a strong masculine head, indicating vigour and constitution, it should also possess that body-weight required for the breed it represents.

The novice is often inclined to select as future breeders those Leghorn cockerels which crow first, have the largest combs, and are the most precocious. However, this class of cockerel may be likened to the pullet that matures and starts to lay at four months and a half old. They seldom make good breeders, as they come to maturity before their frames have had time to develop, and although they show up early and appear to grow more quickly up to a certain period than the rest of the brood, it will be noticed a little later that those birds that develop a little more slowly, with a well-proportioned body and no excessive development of the comb, generally turn out the best. Therefore when selecting early cockerels it is advisable to select those with good, well-proportioned bodies, that show character, will not be harassed by the rest, show vigour and constitution, but seem to develop their frames first and the reproductive organs after.

Culling of Hens.

Opportunity should be taken at the present time to go carefully through the flock and cull out any hens showing lack of vitality and constitution. Hens which are overfat, thick of abdomen, dried up in comb, or coarse in pelvic bones, Leghorn hens with yellow legs and beaks, at this time of the year may safely be put out. By handling a few birds regularly the novice soon gets into the way of picking the laying-hens from the non-producers.

A good layer's abdomen is soft, thin, and flexible like the udder of a good milking-cow, the pelvic bones are thin and pliable, while the poor layer's or non-producer's abdomen usually is thick and coarse in comparison, and at times rather hard, while the pelvic bones usually are thick and stiff.

Where a large number of birds is kept and culls are being marketed regularly it is a good plan to have a few fattening-coops or a small yard where stock can be primed for a couple of weeks before being sent to market, and when birds are sold alive in the market, if they are carefully graded into even sizes, they sell better and realize higher prices than when sold ungraded.

The Young Growing Stock.

Now that the weather is becoming warmer and the young stock are growing, they need more room in their sleeping-quarters. Never let growing birds crowd even for one night, as a few hours of crowding may cause colds to break out. Many outbreaks of cold and roup have been traced to the overcrowding of colony houses and young-stock pens. A visit to these quarters after the birds have gone to roost is time well spent, for though there may be plenty of perching-accommodation young birds are often inclined to crowd together. If this is noticed to be the case, and the birds are gently spread out for a night or two, the habit is broken and much trouble may be avoided. In fact it is advisable if at all possible to place in the colony houses or young-stock sheds only that number of birds that the house suitably accommodates when the birds are grown. By so doing a better class of bird is raised, and there is not the danger of outbreaks of colds or roup.

Care of Incubators.

Now that the hatching-season is over all incubators should be thoroughly washed out with hot water, soap, and disinfectant, and then

left open for a few days so that they may dry out. The lamp and burners should be washed in boiling water, and when dry placed inside the incubator. It is also advisable to unscrew the regulating parts, and place them inside the machine, so as to prevent their being bent or knocked about. The incubator itself should be covered over with a cloth, as by doing this the life of the machine will be lengthened and the value maintained.

Nesting Material.

Various kinds of nesting materials are used by different poultry-keepers In order to ascertain if birds showed any preference for any particular nesting material a test was carried out at this Department's Wallaceville Poultry Station during the month of July. In each of three houses which housed a total of 140 White Leghorn hens, fourteen nests of a similar make were placed. Two nests in each house contained straw as a nesting material, two pine needles, two straw chaff, two lucerne chaff, two sand, two sawdust, and two oyster-shell grit. The result of the test was that 1,629 eggs were laid during the month: 600 of these were laid in the nests containing straw as a nesting material, 345 in pine needles, 312 in straw chaff, 230 in lucerne chaff, 79 in sand, 44 in sawdust, and 19 in the oyster-shell grit.

While straw proved the most popular with the hens, it did not prove the best nesting material, as, owing to the size of the nest-boxes, the straw nests had a tendency to become too saucer-shaped or deep, with the result that the eggs rolled too much together and more were cracked or broken in these nests than in any of the others. The nest-boxes at Wallaceville are 14 in. deep, 12 in. high, and 12 in. wide.

Straw chaff proved a popular and satisfactory nesting material, but if that material is used care should be taken to see that at least 2 in. deep is used in each nest.

It may be mentioned that previous to this test only fine sand was used in all nests. Straw is more suitable for use in larger nests, and when it is used it is advisable to see that straw is first rubbed between the hands in order to break it up, and too much should not be used in each nest.

—*C J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Artificial Increase.

MANY methods are in vogue relative to what is commonly termed "increase." The word in this case means adding to the number of colonies. Strong stocks are built up by early feeding, and then are divided, the portion containing the old queen being removed to a new location. As nearly as possible an equal part of brood and stores is given to each, and the remaining space is filled with frames of foundation. Early queens must be reared and introduced to the half that is queenless, or, failing this, a ripe cell should be inserted.

For rapid increase this method is perhaps the best known in bee-culture, and is highly recommended. Always remember a good spring is necessary to ensure the young queens mating in time. If a large number of colonies are required those already divided may be further fed with sugar syrup or sealed stores, until sufficient strength has been gained for a second division. Just here judgment is required as to whether some stocks are too weak for a second division, for only the very strong should be so broken down.

Queen-rearing.

During the summer months every attention should be paid to raising a stock of young queens to replace old and failing ones. Buying new

queens each successive season is too expensive, and with a little attention and care good queens can be raised by the beekeeper in his own yard. An apiary should be requeened as a rule each year, and queens should not be tolerated for more than two seasons at the most. In the long run the queens tell in the production of big crops, and unless the beekeeper takes the trouble to requeen in the summer only a small proportion of the stocks will yield a surplus. Perhaps no branch of apiculture receives less attention than the production of young queens; and yet if the beekeepers who get the big crops of honey are asked what counts most in their production the reply is invariably, "Young queens." In New Zealand it has been proved over and over again that the best period for raising queens is from November to February. During these months everything is favourable for the operation, as the hives are at their highest state of prosperity, and under normal conditions the workers and drones are at their best.

It is best to breed only from pure Italian queens whose correct mating has been assured. Novices can judge the mating by noting the uniformity of the hatching brood as regards colour. Should the young worker bees show diversity of colour—some being yellow-banded and others quite black—the mating has not been correct. The question of mating is always a difficult one, as queens mate on the wing, and therefore it is impossible for the apiarist to select the sires. But as purebred queens, even though mismated, throw pure drones, it only takes a comparatively short time to eliminate crossbred drones from an apiary. There is, however, still the chance of contamination from other drones in the neighbourhood. To sum up the matter, by persistently breeding from the best it is possible to achieve excellent results, while under careless management, or, as is often the case, no management at all, bees are sure to deteriorate.

Methods of queen-rearing are legion, but may be roughly divided into two classes—namely, those which use the naturally built queen-cells, and those which necessitate the provision of artificial queen-cups into which young larvæ are transferred. The former method is most suitable for beginners, or for use early in the season, as it minimizes the risk of chill to young larvæ; while the second method is used largely by beekeepers who want to rear queens in greater numbers.

The Alley System: A simple, efficient, and easy method for raising queen-cells may be found in the Alley plan. It must be understood, however, that when raising queen-cells they require to be large and well-shaped, and that any cells not up to size should be cut out. Procure a frame of young larvæ from the breeding-hive, and with a sharp knife proceed to cut every second row of cells down to the midrib of the foundation. Next kill two out of every three larvæ, and cut the comb into strips about 1 in. wide the full length of the frame. These strips are fastened with melted wax to cell-bars that hang about midway in a standard frame. The cells are pared down to about ⅜ in. in height, which gives the bees room to construct a solid base for the queen-cell The frame or frames containing these bars, with the strips attached, may now be put into the hive previously prepared for their reception.

The Miller Method: The Miller method of raising queen-cells will be especially useful to the novice or to the beekeeper wishing a few cells at one time. It is simple, easy, and under normal conditions never fails. No extra appliances are needed. Perhaps no better outline of the Miller system can be given than the original one which appeared in the *American Bee Journal* for August, 1912, as follows:—

"Into an empty brood-frame, at a distance of 2 in. to 3 in. from each end, fasten a starter of foundation about 2 in. wide at the top, and coming down to a point within an inch or two of the bottom bar. Put in the hive containing your best queen. To avoid having it filled with drone-comb, take out of the hive, either for a few days or permanently, all but two frames of brood, and put your empty frame between these two. In a week or so you will

find this frame half filled with beautiful virgin comb, such as bees delight to use for queen-cells. It will contain young brood with an outer margin of eggs. Trim away with a sharp knife all the outer margin of comb containing eggs, perhaps a few eggs next to the youngest brood. This you will see is very simple. Any beekeeper can do it the first time of trying, and it is all that is necessary to take the place of preparing artificial cells. Now put this 'queen-cell stuff,' if I may so call the prepared frame, into the middle of a very strong colony from which the queen has been removed. The bees will do the rest, and you will have as good cells as you can possibly have with any kind of artificial cells. You may think that the bees will start 'wild cells' on their own comb. They won't. At least, they never do to amount to anything, and, of course, you needn't use those. The soft, new comb, with abundant room at the edge for cells, is so much more to their taste that it has a practical monopoly of all cells started. In about ten days the sealed cells are ready to be cut out and used wherever desired."

Nucleus Hives.

In order to facilitate the work of queen-rearing a few nucleus colonies should be run in conjunction with every apiary. In these small colonies queens can be raised and cared for until they are mated and laying. It is an easy matter, once the queens are laying, to transfer them to the larger hives in the apiary.

The best style of nucleus hive to adopt is the four-frame one. This size gives the young queen a chance to lay once she is mated, and, besides, holds sufficient bees to care for relays of queen-cells throughout the season. To form a nucleus colony take one frame of well-capped brood with adhering bees, and one frame containing honey and pollen, the remaining space being filled with an empty comb and feeder. If the number of bees on the comb is not sufficient to form a good cluster, one or two frames of young bees may be shaken into the nucleus, this being done to replace the field bees which return to the old hive. Place the frame of brood in the middle of the hive and close the entrance until the following day, when the bees may be released. In the course of a day or two the small colony settles down, and then is ready to receive the first queen-cell.

Nuclei thus formed should be placed in a shady position until the bees are released. It is a good plan to set them a fair distance apart from each other and away from the main part of the apiary.

—E. A. Earp Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

During the months of December and January young plants of savoy and red cabbage, broccoli, and cauliflower, Brussel sprouts and kale, leeks and celery are set out for winter cropping. Land from which early crops of potatoes, peas, and salads have been cleared is most suitable for the purpose. Where the initial preparation was good little further preparation will be needed except perhaps for celery, in which case a good dressing of blood and bone, or fish manure, and sulphate of potash, would usually be beneficial. There is often a tendency to force this crop unduly, and the growth is then rank and soft, with considerable loss, very possibly, from fungous and bacterial troubles. Grown steadily, the flavour is improved, and there will be less loss from these causes. On an acid soil all of these crops are greatly improved by an application of lime before planting. Planting at this season must be done with the greatest care to obtain the best results: usually it is necessary to water the plant-beds a day or two before lifting, which should be done in dull weather, and the plants watered

in after planting. The plants should be well rooted and of even size, a sharp watch being kept to avoid those which are "blind" or diseased. Club-root disease is very commonly introduced by setting out infected cabbage plants.

Warm summer days favour the increase of insect pests, so that some protection is usually required during the establishment of these crops. The caterpillars of the white butterfly and diamond-back moth are the common foes of the cabbage family at this season, they may be destroyed before doing serious damage by applying derris dust so soon as the first sign of the attack is perceived, and repeating the application as may be necessary. Green aphides in the hearts of the young plants is also a pest which is commonly present at this period. If they are present when about to plant out, the tops of the plants may be dipped into a solution of nicotine sulphate, one teaspoonful in a gallon of water in which common soap—an inch cube—has been dissolved. Comparative immunity may afterwards be obtained by placing a pinch of tobacco, or nicotine, dust, in the heart of the plant, and so making it distasteful to the insect as a place of residence. The most common trouble threatening the celery crop is of fungous origin and known as leaf-spot, the remedy for which is Bordeaux 3-4-50—*i.e.*, 3 lb. bluestone, 4 lb. hydrated lime, and 50 gallons water. Or washing-soda may be substituted for the lime. Applications should be made at intervals of about three weeks, as may be necessary.

Other crops which may be sown during the above-mentioned period are dwarf beans, early peas, shorthorn carrots, globe beet, turnips, radish, spinach, and lettuce. These are usually the last sowings for the season for all of these crops except spinach and lettuce.

The harvest period for the tomato crop in the unheated glasshouse is now well started, and matters requiring attention chiefly consist of watering, feeding, and attending to ventilation. The outside crop is now well established, and suckering and tying to stakes or wires must be done periodically. In addition to the usual cultivation to suppress weeds, &c., the crop should be watched carefully for any sign of attack from disease or pests. It is now some years since serious losses were incurred by the attack of small moth larvæ tunnelling the main stems of the plants a few inches above the ground, and plants carrying heavy crops collapsed suddenly before the fruit could ripen. This near relation of the potato-moth has been kept under control since by applications, over the vulnerable area more especially, of a solution of arsenate of lead powder, commencing this season.

Early in the month of December, when a good varied supply of early vegetables is available, the harvesting of asparagus should cease and the plants allowed to make normal growth; this usually is greatly assisted by a liberal application of a complete manure at that period.

The pulling of rhubarb also is usually discontinued about that time, which coincides with the commencement of the stone-fruit harvest. A dressing of manures at this stage is usually advisable to encourage vigorous growth.

Where foul land has to be cleaned a summer fallow is often the most effective method when twitch and other bad perennial weeds are present. Generally it is best to plough only moderately deeply, just getting well below the roots of the weeds; then by cultivating and harrowing in fine weather, when the land is dry, the roots are brought to the surface, where they are collected and burnt. The next two or three months are usually the best season for this class of work.

Reports on modern research into horticultural problems are constantly revealing the important part played by many weeds as hosts of insects and disease which affect crops. The work of keeping the crops clean is greatly facilitated by suppressing the weed-growth in their vicinity. By mowing now, with a short weed scythe, hedge bottoms and odd corners of land

where weeds and rank growth have become established, many weeds are killed and others are prevented from seeding, and in all cases the danger from this source is much reduced by this attention. Where young shelter-trees have been planted out in grass this treatment provides a helpful mulch which assists in retaining moisture and admits the light upon which the growth of the young trees depends.

The Homestead Garden.

Where new gardens are to be made it is best to prepare a plan on which ideas may be recorded and adjusted until they harmonize and are well-proportioned. For those who are not accustomed to the work, graph paper 20 in. by 30 in. is very helpful. Its surface is divided usually into squares ten to the inch, and a scale of say, 10 ft. to the inch is easily operated. First draw to scale a plan of the section to be dealt with, then insert a ground-plan of the dwelling and buildings in their respective positions. Follow then with entrance, roads, and service yard, giving access for vehicular and pedestrian traffic. These drives and walks should have an easy grade and be as direct as possible so long as sharp turns, difficult to negotiate with vehicles, are avoided On flat land there is often no reason why they should not be straight, and they are then best made that way, as there must be no straining after effect. A straight drive planted as an avenue can be most effective if it is well-proportioned.

After laying off areas for orchard, crops, and games, the remainder should be sown down to smooth grass lawns and planted in shrubbery borders. Any decorative features which may be suitable and interesting can be incorporated here Two features which should receive special consideration, and should be provided as required, are an effective evergreen shelter-belt on the weather side, and such deciduous shade trees as may be necessary on the lee side of the buildings From this it will be seen that the garden is an integral part of the home in the country, and, in addition to providing a harmonious environment and some supplies of produce, it adds much to the comfort and convenience of the inhabitants. One other point for consideration is that of maintenance. Much of the literature of gardening deals with the production of show blooms for competition—a very fascinating pastime, but the work demands considerable attention One is also strongly tempted to plant a great variety of plants, some of them delicate or poorly suited to the locality Those who have not time or inclination to produce crops which require so much attention may secure all of the amenities of the garden by keeping the selection to plants naturally suited to the environment, and planting them in fairly large groups, especially the smaller subjects The garden need not be less attractive or profitable on that account; in many instances it is quite the reverse.

This is work which cannot be done on the impulse of the moment; many aspects present problems of considerable difficulty which take time to work out satisfactorily. The quality of the finished work depends to a very great extent on the quality of this preliminary preparation. It is best done now so that work may be completed in readiness for sowing down lawns in February–March or August–September and setting out hard-wooded plants during the planting-season, which extends from about May to September inclusive.

Those who have established gardens should also now give them consideration and make definite notes for action at the appropriate season. Time inevitably brings changes, and with a little foresight many of them in the garden will be for the better. Temporary shelter-trees which have served their purpose may be removed, also many "filler" trees and shrubs that are planted out in the early stages of the life of most shrubberies and plantations. Every one makes mistakes, and the planting-season affords an opportunity for putting right some of those made in the garden; as, for instance, the position of specimen trees on a lawn or the wrong position

of a shrub which prefers shade, &c. Many of the best features of a garden can only be planted out satisfactorily when abundant shelter and shade have been established, as for instance, tree ferns, nikau palms, &c. The opportunity is now approaching when brightness, interest, and character may be increased in the garden as required by planning now in some detail such changes as are desirable.

The months of December and January are most suitable for planting out bearded irises. The rich colours and compact growth have brought these plants again into high favour; they have the further advantage of being hardy and requiring very little nursing to obtain a good supply of bloom during spring and early summer. A sunny situation in limestone country is ideal; in the absence of the latter requirement the lime should be liberally provided.

—*W. C. Hyde, Horticulturist, Wellington.*

Citrus culture is making satisfactory headway, especially in the northern districts which are suitable for the production of citrus fruits. The total area now planted in citrus fruit-trees is 1,884 acres, consisting of 1,300 acres of lemons and 584 acres of oranges; 112 acres were planted during the year. *Annual Report, Director-General of Agriculture*

WEATHER RECORDS: OCTOBER, 1936.

Dominion Meteorological Office.

NOTES FOR OCTOBER.

THE first ten or eleven days of October were very windy and rather cool, but otherwise the month was a very mild one. Except in parts of the Wairarapa and southern Hawke's Bay, there has been a vigorous growth of vegetation, and there is ample feed for stock, which are reported to be in very good condition. The milk-yield improved rapidly, and is now high. The lambing-season appears to have been a good one, with relatively few losses owing to adverse weather. As regards fattening, the condition of lambs at the end of the month, though on the whole good, was somewhat variable In some places the grass was still rather soft. In this respect, however, conditions should soon improve Crops have made good growth, but the wet condition of the soil has reduced the sowing of spring wheat in Canterbury

Rainfall.—The rainfall exceeded the average over most of the west coast of the South Island and the Nelson and Marlborough Provinces, but elsewhere it was below Large parts of the North Island and also of Canterbury had only half the normal fall

Temperatures were everywhere above normal. In eastern districts and the interior the departures were generally somewhat over 2°, and elsewhere mainly between 1° and 1·5 Frosts were infrequent and not, in general, severe. A rather sharp one occurred, however, on the morning of the 15th. In the Hastings district, following immediately on a cold rain with snow on the high levels, it caused very serious damage to fruit and tomato crops. A few days later, considerable damage was done in orchards in parts of Central Otago.

Sunshine --The duration of bright sunshine was generally below average, and especially so in western districts from Taranaki southwards A few places in the interior and the southern parts of the South Island had more than usual

Pressure Systems -During the first eleven days a series of vigorous westerly depressions crossed the Dominion, and north-westerly or westerly gales were blowing in some part or other almost throughout. The gale of the night of the 8th to morning of the 9th was particularly severe, and some damage was done, especially in the Wellington, Westland, and Canterbury Provinces The gale was accompanied by general rains, which were very heavy on the West Coast and in the high country of the South Island. Floods occurred on the West Coast, that at Greymouth being reported as the highest for twenty-two years The Waimakariri River, also, was in high flood, the highest level exceeding anything during the preceding sixty years. On the 11th to the 12th the weather changed, the winds turning to southerlies, which were strong about Cook Strait. Some snow fell on the ranges and in the high levels of the South Island. South-westerly weather predominated until the 16th, gales were recorded at times in many places On the 14th there was again snow on the ranges, and on the following morning severe frosts were experienced in the central part of the North Island From the 19th to the 27th the pressure systems were much more slowly moving and irregular in form Useful rains fell, especially in the northern half of the North Island. Temperatures were unusually warm for the time of year.

During the last three days the westerly type of weather again became established. The persistent westerlies were responsible for frequent rains throughout the month in western districts of the South Island, but to the northward the amounts fell off rapidly and eastern districts were, of course, to a large extent shielded from the rains.

RAINFALL FOR OCTOBER, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average October Fall.	Total Rainfall to Date.	Average Rainfall to Date.
			North Island.			
	Inches.	Inches.	Inches.	Inches	Inches.	Inches.
Kaitaia	3·99	16	1·54	5·27	48·46	48·93
Russell	4·49	10	1·91	3·98	80·98	45·17
Whangarei	4·31	17	1·23	4·76	58·43	54·71
Auckland	3·15	14	2·00	4·06	45·72	42·58
Hamilton	2·88	16	0·55	4·60	44·67	42·03
Rotorua	2·54	11	0·86	5·19	53·67	47·10
Kawhia	2·42	8	0·73	5·15	48·18	45·90
New Plymouth ..	2·89	16	0·57	5·46	50·66	50·79
Riversdale, Inglewood ..	6·43	18	0·91	10·41	82·35	87·57
Whangamomona ..	..	..	..	8·43	..	64·53
Hawera .. .	1·59	10	0·34	4·65	38·04	38·18
Tairua	2·72	12	0·95	5·81	44·98	56·44
Tauranga	2·58	12	0·74	5·11	48·11	45·52
Maraehako Station, Opotiki	..	..	..	5·35	..	47·29
Gisborne	1·39	6	1·16	2·67	37·34	39·95
Taupo . ..	2·51	11	0·82	4·31	42·20	37·43
Napier	1·23	11	0·85	1·89	41·73	26·12
Hastings	1·12	8	0·47	2·11	36·20	28·16
Whakarara Station ..	3·25	12	0·92	.	47·01	..
Taihape	1·79	16	0·39	3·50	37·56	30·06
Masterton	3·08	10	1·32	3·24	41·16	32·78
Patea	2·77	15	0·66	4·25	41·80	37·28
Wanganui	2·14	9	0·57	3·46	34·17	30·18
Foxton	2·36	12	0·77	2·94	34·43	26·67
Wellington	3·33	14	1·15	3·51	46·28	36·38
			South Island.			
Westport	..	..	..	8·70	..	79·50
Greymouth	11·33	22	2·17	10·74	77·62	83·80
Hokitika	11·40	21	2·34	11·81	86·64	94·12
Ross	10·07	20	3·30	14·77	106·39	109·58
Arthur's Pass ..	30·43	18	7·08	20·33	118·26	131·69
Okuru, South Westland	19·97	14	4·98	15·21	130·41	120·90
Collingwood	8·90	15	1·95	10·08	80·34	82·03
Nelson	4·10	9	1·19	3·50	35·64	31·94
Spring Creek, Blenheim	2·73	10	0·93	2·56	31·03	25·79
Seddon	1·73	10	0·60	2·23	24·43	20·99
Hanmer Springs ..	5·38	14	2·43	3·92	48·50	37·83
Highfield, Waiau ..	..	..	..	2·60	..	28·12
Gore Bay	..	..	..	2·33	..	26·58
Christchurch	0·98	10	0·31	1·97	28·64	20·89
Timaru	0·64	6	0·29	1·98	23·57	18·31
Lambrook Station, Fairlie	1·81	7	0·54	2·06	22·39	20·37
Benmore Station, Clearburn	..	..	..	2·30	..	20·25
Oamaru	0·95	7	0·34	1·76	20·48	17·84
Queenstown	4·79	16	1·07	3·31	31·68	25·28
Clyde	1·52	7	0·58	1·62	11·91	12·12
Dunedin	2·86	11	1·51	3·09	37·21	29·97
Wendon	2·64	11	0·90	2·73	25·80	24·42
Balclutha	..	..	..	2·52	..	20·58
Invercargill	4·28	18	1·00	4·35	39·65	37·37
Puysegur Point ..	11·19	26	1·62	8·13	87·82	69·84
Half-moon Bay ..	..	..	..	5·16	..	48·10

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TURNIP-MOSAIC.

A VIRUS DISEASE OF CRUCIFERS.

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TURNIP-MOSAIC was first recognized in New Zealand in 1932, when it was observed on rape-plants being grown for seeding purposes at the Plant Research Station Area, Palmerston North. Since then it has become a serious disease of swedes, rape, and turnips at the Station Area, and has been found also in a number of districts throughout the Dominion.

The first accounts of turnip-mosaic are from North America, where it was recorded simultaneously by Gardner and Kendrick (1921) and Schultz (1921). It has also been recorded from Denmark (Gram and Rostrup, 1924), Germany (Pape, 1935), England (Smith, 1935), and Australia (Samuel, 1931).

SYMPTOMS.

On swedes the characteristic symptom of the disease is a mottling and crinkling of the leaves. The mottling is diffuse, the difference between the light and the dark areas being slight (Fig. 1). Less commonly, it occurs as dark-green blistered areas Symptoms appear only on those leaves which develop after infection has taken place. Infected plants soon become stunted in appearance (Fig. 2), and the "bulbs" (the bulbous portion of the roots), although they continue to grow, are much smaller than those of healthy plants. The leaves of infected plants tend to die prematurely (Fig. 3), and under certain conditions the "bulbs" become susceptible to soft-rot.

In stecklings* during the winter and early spring the symptoms appear as a pronounced mottling of the leaves with little or no crinkling. Infected plants remain stunted and produce a light crop of seed.

In the glasshouse mottling and crinkling are preceded by a clearing of the veins on the developing leaves. This vein clearing, which is a loss of the green colour along the veins, is rarely seen under field conditions.

* Plants of autumn sowing used for seed-production

On turnips, symptoms, although much the same as for swedes, tend to be more pronounced. Thus leaf-mottling is usually more clearly defined (Fig. 4) and the distortion of leaves and the stunting of plants greater (Fig. 5). Infected plants are also much more susceptible to soft-rot.

On rape the disease produces a definite mottling of the leaves, but leaf distortion and stunting is not as pronounced as with swedes or turnips. There does not appear to be any premature death of leaves, and, after "feeding-off," the plants produce new growth which is, however, still mottled and stunted.

FIG. 1. TURNIP-MOSAIC ON SWEDE LEAF.
Healthy leaf on right.

INCIDENCE.

The disease was first observed in 1932 on a few rape plants at the Plant Research Station. In the following year it was found to be common on swedes, rape, and turnips at this area, and was also prevalent on the two former hosts in varietal trial plots at Marton. At the Station Area the amount of infection has increased each year until in the past season practically all swedes and rape were infected.

An inspection of several rape crops in the Marlborough district made during the past season showed a small percentage of mosaic

to be present in each. In a recent survey of swede crops a small amount of turnip-mosaic was found in the Otago and Rangitikei districts.

The disease has also occurred during the past three seasons in crops (approximately 2 acres each season) of swede stecklings grown at Colyton, in the Manawatu district. On this area, in the spring of 1935, from 2 per cent. to 3 per cent. of the plants showed infection early in the season.

ECONOMIC IMPORTANCE.

The only country in which turnip-mosaic has been reported to be of economic significance is Germany (Pape, 1935). In that country Pape stated that infection on swedes in Schleswig-Holstein was found to range from 1 per cent. to 90 per cent., and that in two test plots the reduction in yield amounted to 63 per cent. and 57 per cent. respectively.

At the Plant Research Station Area at Palmerston North, where the crops are grown for experimental purposes, turnip-mosaic is a serious disease. It has been particularly severe on turnips, for not only have they become infected with mosaic but the " bulbs " have been subsequently attacked and destroyed by soft-rot. During the past season the effect on swedes was almost as severe, for in several plots the secondary attack by soft-rot destroyed a large percentage of " bulbs." In other plots soft-rot was not responsible for such heavy losses, but the effect of the mosaic was sufficient to render valueless experiments on the control of brown-heart. The effect of the disease on rape was not so pronounced, being limited to stunting of the plants.

Attempts to carry out yield trials with healthy and infected swedes and turnips failed because control plants could not be kept free from mosaic throughout the season. Trials with rape were more successful, since it was found possible to keep the control plants reasonably free from the disease until the time of cutting and weighing.*

During the 1934–35 season trials were carried out in which 100 each of healthy and mosaic-infected rape-plants were grown in ten replications of ten plants per plot. The weights of green leaf showed for healthy plants an average of 0·57 lb. per plant and for mosaic-infected plants 0·42 lb. This represents a reduction in yield of 25·4 per cent., caused by the disease.

In the 1935–36 season further trials were laid down, but despite frequent spraying to control insect vectors† a certain amount of spread of mosaic occurred. All infected plants were, therefore, harvested and weighed separately. Eighty-eight healthy plants gave an average yield per plant of 1·65 lb., while 112 mosaic-infected plants gave an average yield of 1·22 lb. In this case the reduction in yield was 26·1 per cent.

During both seasons the disease spread so rapidly after cutting that the trials were abandoned.

* The crop was harvested and weighed when the plants had reached maturity—*i.e.*, at a stage of growth when they were fit for " feeding-off "

† The term " vector " is applied to any agent, usually an insect, which transmits a virus from one plant to another.

Identity of the Disease.

The disease as it occurs in New Zealand has every appearance of a virus of the mosaic type. A study of its symptoms, methods of transmission, and host range has demonstrated not only its virus nature, but its similarity to turnip-mosaic described by overseas workers.

Methods of Transmission.

Artificial Transmission.—That infection of healthy plants may be brought about by inoculating them with juice expressed from mosaic-infected foliage has already been shown by workers in other countries (Gardner and Kendrick, 1921; Schultz, 1921; Gram, 1925; Clayton, 1930; Pape, 1935).

Early in 1934 experiments were commenced in New Zealand to determine whether the disease could be transmitted in this manner.

Experimental Method.—The inoculum used was juice extracted from leaves of mosaic-infected plants obtained from the field. All healthy plants were raised in steam-disinfected soil in an insect-free glasshouse. Inoculations were carried out usually on plants in the four- to six-leaf stage by rubbing the leaves with muslin moistened with the above juice extract.

Results.—The results of the artificial inoculations are summarized in Table I.

Table I.—Artificial Transmission of Turnip-mosaic

Date of Inoculation	Source of Inoculum	Species inoculated	Number of Plants inoculated.	Number of Plants infected.
3/1/34 ..	Swede ..	Turnip ..	4	4
3/1/34 ..	Rape ..	,, ..	4	2
3/1/34 ..	Swede ..	Swede ..	4	3
8/10/34 ..	,, ..	Turnip ..	12	8
8/10/34 ..	,, ..	Swede ..	12	5
21/11/35 ..	,, ..	,, ..	8	2

Control plants equal in number to those inoculated all remained healthy.

From these results it is evident that turnip-mosaic is readily transmitted from diseased to healthy plants by juice inoculations.

Insect Transmission.—This was first demonstrated by Schultz (1921), who showed that the aphis *Myzus persicae* was a vector. Clayton (1930) found that the disease was readily transmitted by the aphis *Brevicoryne brassicae*. Working with what was probably the same disease Hoggan and Johnson (1935) showed that both these insects were vectors. Pape (1935) claimed that the disease was also transmitted by the capsid-bug *Lygus pratensis*.

In New Zealand the sucking insects most commonly found on cruciferous crops are the aphides *B. brassicae* and *M. persicae**, so transmission experiments were confined to these.

Experimental Method.—All healthy plants were raised in steam-disinfected soil in an insect-free glasshouse. The infected plants used as a source of inoculum were either transplants from the field or plants

* The identification of these aphides was kindly made by Mr. W. Cottier, Assistant Entomologist at this Bureau.

artificially infected in the glasshouse. The aphides, after being allowed to feed on mosaic-infected plants for at least seven days, were transferred to healthy plants, which were then enclosed in muslin cages in the manner described in a previous article (Chamberlain, 1935). After the aphides had been allowed to feed on the plants for seven to ten days the cages were removed and the plants fumigated. Control plants were treated in a similar manner, except that no aphides were transferred to them.

Results.—The results of the experiments on insect transmission are given in Table II.

Table II.—Insect Transmission of Turnip-mosaic.

Date of Inoculation.	Source of Inoculum.	Species inoculated.	Aphis Species.	Number of Insects transferred.	Number of Plants inoculated.	Number of Plants infected.
13/10/33 ..	Swede ..	Swede ..	*B brassicae*	36	10	7
10/1/34 ..	,, ..	,, ..	,, ..	20	5	3
17/7/36 ..	,, ..	,, ..	,, ..	20	8	8
10/1/34 ..	,, ..	Turnip..	,, ..	20	5	2
8/3/35 ..	,, ..	Swede ..	*M. persicae*..	10	8	8
12/5/36 ..	,, ..	,, ..	,, ..	15	10	5
12/5/36 ..	Brussel's sprouts	,, ..	,, ..	20	10	7
12/5/36 ..	Cabbage ..	,, .	,, ..	15	10	4
12/5/36 ..	Broccoli ..	,, ..	,, ..	12	10	2
12/5/36 ..	Cauliflower	,, ..	,, ..	20	10	6

Control plants equal in number to those inoculated all remained healthy.

These results show that turnip-mosaic is readily transmitted by both *B. brassicae* and *M. persicae.*

Seed Transmission.—Field trials carried out by Clayton (1930) with seed from mosaic-infected swede-plants indicated that the disease was not seed-carried.

The following results, although the experiment was not sufficiently large for conclusive proof, support those of Clayton's, for of 432 plants grown from seed of infected plants none developed mosaic.

Experimental Method.—Mosaic-infected swede stecklings were collected from the field and seeded in the glasshouse. Seed from these plants was sown in steam-disinfected soil and the seedlings pricked out into 4 in. pots. These were kept in an insect-free glasshouse until they had developed to the six-to-eight-leaf stage.

HOST RANGE.

The following cruciferous plants have been recorded as hosts of turnip-mosaic: Turnips (*Brassica rapa*), Chinese cabbage [Pe-tsai (*B. cernua*)], Pot-herb mustard (*B. japonica*)—(Schultz, 1921); swedes (*B. napobrassica*), charlock (*Sinapis arvensis*), *Raphanus* sp.—(Gram, 1925); Chinese cabbage [Pak-choi (*B. napus* var. *chinensis*)], white mustard (*S. alba*), black mustard (*B. nigra*), rape (*B. napus* var. *typica*), Brussel's sprouts (*B. oleracea* var. *bullata*), cauliflower (*B oleracea* var. *botrytis*)—(Clayton, 1930); kale (*B. oleracea* var. *acephala*)—(Smith, 1935).

In New Zealand the disease has been found only on swedes, turnips, and rape. In order to determine whether other cruciferous plants were

susceptible, an attempt was made in one experiment to transmit turnip-mosaic, by means of artificial inoculations, to the following vegetables: cabbage (*B. oleracea* var. *capitata*), cauliflower, Brussels' sprouts, broccoli (*B. oleracia* var. *botrytis*), and radish (*Raphanus sativus*). No infection was secured.

In a second experiment transmission to the same five crucifers was attempted by means of the aphis *M. persicae*. The method used was the same as that already described for insect transmission of the disease between swedes and turnips. On 29th January, 1936, approximately twelve *M. persicae* were transferred from a mosaic-infected swede-plant to each of eight plants of the five above-mentioned species.

FIG. 2. STUNTING OF SWEDE PLANT CAUSED BY TURNIP-MOSAIC.
Healthy plant on left.

Results.—The numbers of plants which became infected in each species were—cabbage, 1; cauliflower, 2; Brussels' sprouts, 8; broccoli, 7; and radish, 0. The ten control plants remained healthy.

These results show that cabbage, cauliflower, Brussels' sprouts, and broccoli are susceptible to turnip-mosaic. The symptoms which appeared on these plants were caused by turnip-mosaic, since by means of aphides the disease was transmitted back to swedes. (See Table II.)

On cabbage, cauliflower, and Brussels' sprouts turnip-mosaic produced a faint mottling in which the darker-green areas lay adjacent to the veins. On broccoli numerous pale-green areas on the leaves caused a distinct but not pronounced mottling. Under the conditions of the experiments the disease did not adversely affect the growth of any of these four hosts; and as the plants became older the symptoms were difficult to discern.

Hoggan and Johnson (1935) found that a mosaic of crucifers in North America, when transmitted to tobacco (*Nicotiana tabacum*), caused conspicuous brown necrotic lesions confined to the points of infection. Similar results have been secured with turnip-mosaic in New Zealand.

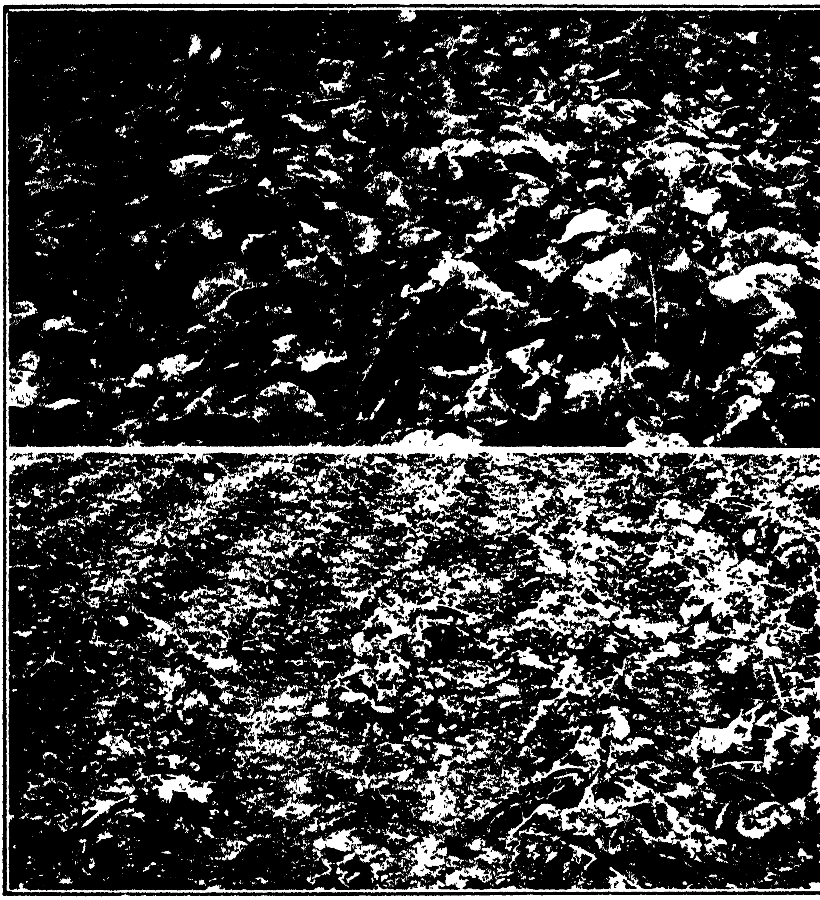

FIG. 3. EFFECT OF TURNIP-MOSAIC ON SWEDE PLANTS IN THE FIELD

Above—Healthy plants; below—mosaic-infected plants Both photographs taken in the same crop early in the season, when the disease was prevalent at one end but not at the other.

VARIETAL RESISTANCE.

Working with turnip-mosaic in Germany Pape (1935) recorded some relatively resistant varieties and others which were severely attacked Amongst the latter was the variety " Yellow Wilhelmsburger."

During the past season a trial of seventy lines of different strains and varieties of swedes, including most of the commonly grown varieties, was undertaken to ascertain their varietal resistance to the

fungous disease dry-rot (*Phoma lingam*). All plants were grown in one block, each line of seed being sown in a row 1 chain long. Plants throughout the block became infected with mosaic, thereby enabling observations on varietal resistance to be made. Counts of infected and healthy plants taken in mid-March, 1936, showed that some ten lines exhibited a degree of resistance (Table III).

Table III.—Varietal Resistance to Turnip-mosaic.

Row No.	Variety.	Strain.	Number of Plants.	Percentage of Mosaic.
9	Wilhelmsburger Otofte ..	Plant Research Station, Selection No 1	74	44·6
10	,,	Plant Research Station, Selection No. 2	87	58·6
11	,,	Canadian Strain ..	76	68·4
12	,,	Johnson's Benefactor Strain	77	57·1
13	,,	Plant Research Station, Selection No 3	78	73·1
26	Imperial	Webb's No 2 Strain ..	57	63·2
30	White-fleshed Purple Top	Sutton's Sensation Strain*	76	0·0
41	Wilhelmsburger Otofte ..	Danish Strain ..	64	78·1
52	,, ..	English Strain (Sharpe's)	63	73·0
69	Sharpe's A1	(Sharpe's)	63	71·4
	Average of the sixty other lines ..		65 4	92·7

* Sutton's Sensation is merely an improved selection of Vilmorin White-fleshed Purple Top (Hadfield and Calder, 1935). The original Vilmorin strain was not included in the seventy lines under trial.

Outstanding amongst the ten varieties showing resistance was Sutton's Sensation. Although this variety is highly resistant it is not immune, as mosaic symptoms appeared on a few plants later in the season. The seven strains of Wilhelmsburger grown in the trial all showed resistance to infection. Not only did this variety show resistance to turnip-mosaic, but it was also much less susceptible to a secondary attack by soft-rot.

CONTROL MEASURES.

In New Zealand turnip-mosaic has become of economic importance only in areas of intensive cultivation. From this it would appear that the disease is most likely to become troublesome in seed-producing areas.

The following recommendations are made for the control of turnip-mosaic in crops grown for seed: (1) Dipping the leaves of plants, at the time of transplanting, in a solution of nicotine or nicotine sulphate to kill insect-vectors (concentration: Nicotine, 1 part to 2,000 parts water; nicotine sulphate, 1 part plus 4 parts soft-soap to 800 parts water). (2) Regular inspection of the crop and rogueing of all infected plants. (3) The avoidance of other cruciferous crops in the vicinity. (4) Keeping the area as free as possible from volunteer seedlings. (5) When mosaic has appeared, spraying the plants with a nicotine spray (concentration as above) to destroy aphides.

FIG. 4. LEAF OF MOSAIC-INFECTED TURNIP.
Healthy leaf on right.

FIG. 5. MOSAIC-INFECTED TURNIP
Healthy plant on left.

SUMMARY.

(1) Turnip-mosaic, a virus disease of swedes, turnips, and rape, is recorded as occurring in a number of districts throughout New Zealand.

(2) The symptoms of the disease are a mosiac mottling and crinkling of the leaves and a stunting of the plants.

(3) Infected turnips and, under certain conditions, swedes become susceptible to a secondary attack by bacterial soft-rot.

(4) Although not reported to be of economic importance in field crops, turnip-mosaic has been a serious problem on experimental areas at Palmerston North and Marton, and has been troublesome on a seed-producing area at Colyton.

(5) Yield trials with rape have shown that it causes on this host approximately 25 per cent. reduction in yield.

(6) The disease has been transmitted artificially by the leaf-rubbing method.

(7) The aphides *Brevicoryne brassicae* and *Myzus persicae* have been shown to be vectors.

(8) No seed transmission was secured in a small trial involving 432 plants grown from seed of infected swedes.

(9) The disease has been transmitted to cabbage, cauliflower, broccoli, and Brussel's sprouts. It causes only mild symptoms on these hosts.

(10) It may also be transmitted to tobacco, where it produces brown necrotic lesions confined to the points of infection.

(11) Field observations indicate that Sensation swede (a Sutton's selection of White-fleshed Purple Top) is highly resistant to mosaic infection, while Wilhelmsburger, Webb's No. 2 strain of Imperial, and Sharpe's A1 are moderately so.

(12) Recommendations are made for the control of turnip-mosaic in seed crops.

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A development that may be expected to follow naturally from the unified thought and co-operative effort that are considered desirable in the work of the Department is a trend towards standardized practice, which, reflecting the best knowledge available, should lead to greater general efficiency, begetting both increased production and improved quality in our farm products. ***Annual Report, Minister of Agriculture.***

PASTURES AND THEIR IMPROVEMENT IN RELATION TO THE MANAGEMENT OF FOOT-HILL FARMS IN CANTERBURY.

WITH SPECIAL REFERENCE TO PLOUGHABLE AREAS.

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THE foothill areas of Canterbury consist of a large portion of the province, extending from the Conway River in the north to the Waitaki River in the south, a distance of some 230 miles. This same area varies in width from a few miles behind Methven and Mayfield to some 80 miles in a part of North Canterbury, with much variation between these limits. Except in parts of North Canterbury, the climate generally is more severe and the rainfall higher than on the Plains. There is, of course, much variation. The soil, in general, is second class, but much variation exists, so that good rich pockets and small flats are not uncommon. Large areas of tussock and also of third-class land- poor, clay, scrub country—are prominent in certain districts A rough estimate of the area of the foothill farms in Canterbury is 2,000,000 acres.

A typical farm or small sheep-run in this area consists of some medium flat land, a fair proportion of rolling downs with steep gullies, and possibly an unploughable tussock or scrub area. The total ploughable area varies considerably between properties, but on an average might be one-half to three-quarters of the area of the farm, the total area of which might be 1,200 acres The average carrying-capacity would be one to one and a half sheep per acre, and a few cattle would be carried The sheep, in the main, are half-breds, but in many of the wetter and colder districts and on the sour, clay soils Romney sheep are preferred. Corriedales constitute a fair proportion of the sheep of North Canterbury

Ewe hoggets are kept each year for flock maintenance. Surplus four- and five-year-old breeding-ewes, fat and store lambs, some fat ewes, store wethers, cull ewe lambs, and cull two-tooth ewes, together with wool and some cattle, constitute the main source of farm income In recent times a few specially favoured properties with some suitable land have grown small areas of wheat and rye-grass seed. The production of these crops however, is a precarious undertaking on account of the risks of winter flooding and strong winds and wet weather at harvest.

GENERAL FARM PRACTICES IN THE AREA.

Apart from the breeding of sheep and the general routine of sheep husbandry, the farm-management centres round the provision of winter feed, spring lambing feed, and some fattening feed. The constant breaking-up of old run-out pastures and the sowing-down of new ones is a very important phase of the management policy.

Turnips provide the bulk of the winter feed, green oats and newly sown temporary or permanent pasture what lambing green-feed there is, and rape, kale, and turnips sown with grass or alone the fattening feed. On well-managed properties oat-sheaf chaff and,

to some extent, hay provide the reserve winter feed. There is nearly always adequate summer feed, although in parts of North Canterbury, on account of the dryness, summer and early autumn feed are often a more acute problem than winter feed.

New pastures are sown each year in the normal course of supplementary-feed production. They are nearly always sown with one or other of the supplementary-feed crops previously mentioned, and are not usually sown with a view to securing a first-class permanent pasture. The success of the establishment of pastures sown in this fashion depends on the seed-mixture used, the soil condition at sowing, the strike and vigour of the supplementary crop, the severity of the grazing when the supplementary crop is being eaten off, and other factors which usually are considered not from the point of view of securing first-class pasture, but rather from that of a first-class supplementary crop. The result is that such new pastures, at their best, can only be mediocre. They soon deteriorate to inferior swards, which sweet vernal and brown-top readily invade and soon dominate.

The soils in these areas respond to top-dressing with phosphate and lime, a practice which, because of the poorness of the new pasture, can rarely be considered economic. At any rate, systematic pasture top-dressing is rarely practised. Though the best permanent pastures are desired they are secured only occasionally by the "chance" or "hit and miss" principle of the use of unsatisfactory seed-mixtures and sowing-down methods. Even when the best seed-mixtures are sown and "chance" good pastures are secured, these are rarely top-dressed and therefore are not maintained.

PRESENT PASTURES.

The greater proportion of the pastures on the foothill areas are poor, and consist mainly of brown-top, sweet vernal, danthonia, some creeping-fog, trefoil, hair-grass, and other low-producing species. Some volunteer white clover and odd cocksfoot and rye-grass plants are present in a few pastures. Often dogstail, and occasionally timothy, are to be found. Brown-top and sweet vernal, though, are the dominant grass species, and often form dense turfs of badly grazed and unpalatable roughage. These pastures give a low carrying-capacity.

Improperly sown new pastures, because of their openness at the start, soon become invaded with these low-producing species. Without manurial treatment the good species that may be sown and that have survived the maltreatment associated with the turnip or other supplementary companion crop cease to retain their vigour after the first year. Such pastures steadily deteriorate, giving a progressively lower grazing-capacity, and subsequently the brown-top becomes sod-bound, with a still lower grazing-capacity. If it were not for the cost of renewal and the fact that all the other pastures on the farm are waiting to be renewed, such a deteriorating newly sown pasture could, with advantage, be ploughed, and again renewed in its third or fourth year. The pasture, however; may not be renewed for eight or even more years.

A low carrying-capacity of a poor-quality feed means low production, and consequently acts as a limit to farm income. Because of this, the pastoral problem on the foothill areas is most

important, and, provided there is good farm-management generally, the farmer's maximum profits depend upon the success with which this problem is handled.

An Improved Method of sowing Grass on these Areas.

As already stated, turnips are sown for winter feed, green-feed is required in spring, and some fattening feed is usually grown. By a reorganization of the cropping programme to allow the sowing of turnips alone or with a very light seeding of Italian rye-grass, the land, after the turnips are eaten off, can be ploughed in the spring, given ideal treatment in the average season, and sown to grass in November–December or January–early-February. On land where annual weeds such as spurrey are troublesome, ideal preparation of the seed-bed should be continued until February to allow early autumn sowing. The inclusion of ½ lb. per acre of rape, kale, or chou moellier gives an extra bulk of fattening feed without harming the new grass by smothering or by excessive tramping as when feeding-off a heavy supplementary crop. The grass (and clovers), because of the fallow, the manure used, and the time of sowing, forms a dense sward of desirable species from the commencement, thus giving little opportunity for the invasion of inferior species. Liberal top-dressing in the first year, followed by annual top-dressing, together with suitable grazing-management, maintains a first-class sward of high carrying-capacity on any of these areas

The value and importance of sowing in this fashion lies in the fact that a dense complete sward of desirable species is obtained at the outset. If followed up by a regular systematic top-dressing policy such a sward can be maintained indefinitely, whereas a poor open pasture on this class of ploughable land can never, within the bounds of practical and economical farming, be improved except by ploughing and resowing.

Pasture Species sown: Seed-mixtures

Improved permanent pastures have been secured by sowing various mixtures under different conditions of soil and climate. The species included in these mixtures have been true or certified perennial rye-grass, cocksfoot, timothy, dogstail, ordinary red clover, certified white clover, subterranean clover, Montgomeryshire red clover, and lucerne. All of the following mixtures, as well as others not given, have been sown on different farms. On several farms two or three of these mixtures have been used on different fields at different times.

Seed-mixture Sown (Pounds per Acre).

——	(1.)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Certified perennial rye-grass	30–35	28–30	28–30	30–35	30–35	28–30	28–30	28–30	4–5	4–5	28–30	28–30	28–30
Cocksfoot: Minimum germination, 75 per cent.		8–12	8–12			8–12	8–12	8–12	12–15	12–15		8–12	8–12
Certified white clover			1–2	1–2	1–2	1–2	1–2	1–2	1–2	1–2		1–2	1–2
Red clover	4–5	4–5	3–4	3–4		3–4	3–4	3–4	3–4		3–4		
Montgomeryshire red clover	.				3–4					3–4		3–4	3–4
Subterranean clover	..		.			1–2	.					1–2	..
Lucerne	.			.						2–4	2–4	2–4	.
Timothy	..	.	.			.	1–2	.		.			.
Dogstail	.		.		..			½–1					
Total	34–40	40–47	40–48	34–41	34–41	41–50	41–50	40½–49	21–27	22–30	33–38	43–54	40–48

It will be seen at a glance that all permanent-pasture seed-mixtures contain true or certified perennial rye-grass, most of them include cocksfoot, and a very large proportion include wild or certified white clover. Red clover also is very commonly used when sowing down these improved permanent pastures. During the last year or so, with the cheapening of Montgomeryshire red-clover seed, this plant has been used in a few instances. It is anticipated that it may gradually replace red clover as farmers themselves gain more experience of the value of high-producing permanent pastures and the use that Montgomeryshire red clover can be in these swards. Timothy and dogstail are added to the mixture by some farmers in certain districts. Subterranean clover is being sown in the seed-mixture used on the poorer soils in parts of North Canterbury, and could be used more extensively with advantage. Lucerne is sown in the grass mixture only in parts of North Canterbury, and here it performs the very useful function of giving feed longer into the dry weather than other species. Because cocksfoot is partially smothered by and eaten out in a vigorous rye-grass stand, some farmers have omitted it from their mixtures. On all the better and heavier soils this does not appear to be a disadvantage. Regardless, almost, of soil or locality under Canterbury foothill conditions certified white clover should always be sown. It is the foundation of improved and top-dressed permanent pastures. On the poorer soils subterranean clover should, on at least a large proportion of the farm, be a companion to white clover in soil and pasture improvement. Of the mixtures given, No. 3 and No. 4 are the most commonly used. A few farmers are using Nos. 5, 6, and 13. In North Canterbury No. 10, No. 11, and No. 12 are in favour. No. 1 cannot be recommended for a permanent pasture, and No. 2 is inferior in value to No. 3 unless a good growth of volunteer white clover can be brought about by top-dressing. Dependence on volunteer white clover, however, is definitely not advisable.

Manurial Treatment and Grazing-management.

Liberal manuring and liming when sowing and during the first year of the life of the new permanent pasture is most important. Common practice is to use 1 cwt. to 1½ cwt. of superphosphate per acre at sowing-time. Top-dressing is commenced in the first autumn with 1 cwt. to 1½ cwt. of superphosphate and 4 cwt. to 5 cwt. of carbonate of lime. Subsequently about 1 cwt. of superphosphate is applied each autumn, and 4 cwt. to 5 cwt. of lime at two- or three-year intervals. With this manuring on the poorer soils a stage of pronounced weakness is often apparent during the second year of the life of the sward.

In one instance, on poor clay soil on one of these foothill farms, 3 cwt. of superphosphate and 3 cwt. of lime (carbonate) were sown with the seed in early February, 1 cwt. of superphosphate and 5 cwt. of lime applied in April as soon as the new sward would carry the drill (used for top-dressing), 1 cwt. of superphosphate applied the following spring, and 1 cwt. of superphosphate applied the same or following autumn, which was last autumn. The pasture is now one and a half years old. It is an excellent sward. The certified white clover and the red clover have developed, the rye-grass has already passed through a slight weakening stage, and the cocksfoot is growing well on this poor soil, which " would not grow good permanent pasture " according to

all local evidence. This is on a farm at present carrying half a sheep per acre. The new pasture, the first of the improved type on this farm, has averaged just over two sheep per acre since sowing, as well as producing 20 bushels of perennial rye-grass last summer.

The grazing-management has been along the usual lines of judicious controlled grazing—*i.e.*, the new pasture has neither been punished nor allowed to get out of hand. It has, during the period, been grazed to suit the pasture.

A special feature of the grazing-management, however, in the first and second summers following spring sowings and the first summer following autumn sowings is to graze the pasture lightly or to spell it entirely for approximately a two-months period in summer—November–December or December–January appear the best periods—for the purpose of allowing clovers to develop. The particular pasture in question was shut for rye-grass seed on the 1st November, mowed and header-harvested in January, and not grazed until 23rd January, by which time there was a good second growth of red and white clover.

The poorer the soil the more important is this treatment on account of the value of clovers in the building-up of the rye-grass of the sward. On really good soils little spelling, if any, may be necessary. This practice of spelling should not be such that growth gets out of hand, but merely sufficient to allow the clovers, which are readily eaten out in a sward of relatively unpalatable permanent rye-grass, especially on poorer soils, to develop freely and become established as an integral part of the new permanent pasture.

Importance of Top-dressing.

Some farmers have occasionally put this policy of pasture renewal into practice and omitted on one or two paddocks, or, worse still, perhaps, on the first pasture sown the necessary manurial treatment. For the first six months, year, or perhaps eighteen months, according to the quality of the land, the new pasture has been apparently all that was expected, but soon the rye-grass has become hard and unpalatable, clovers have failed to develop, and inferior species have entered readily. Disappointment has been the result, and the policy for improvement abandoned.

It has become demonstrated amply that unless a suitable annual top-dressing programme has been conscientiously followed any policy for pasture improvement on these soils is only of passing value. Experiences to date are convincing that there is no permanent gain by properly sowing valuable pasture-seed mixtures without fertilizer.

Some Benefits from Improved Permanent Pastures on Foothill Farms

Improved permanent pastures of high carrying-capacity mean improvement to the farmer's property. His assets are increased. The only measure of this increase in assets is the increase in productive value (or net returns). This is very largely dependent upon the area sown to good pasture and maintained as such. Very few farmers, if any, in the foothill area have definitely planned a pasture-improvement policy along the lines indicated for more than five or six years, so that assuming an annual sowing-down of 5 per cent. to 7 per cent.

of the farm (and without capital expenditure little more than this area can be sown down annually) the yearly increase in assets must of necessity be small. There remains a large area yet to be dealt with, and much scope for increasing carrying-capacity, and thus assets, on most of these properties.

Over the short period of development mentioned, several properties have increased their sheep numbers by 20 per cent. to 25 per cent., a large number by smaller percentages, and one property by 46 per cent. It is safe to forecast that many of these properties will more than double their carrying-capacity as development progresses.

Efficiently managed, improved, and top-dressed pastures also enable more lambs to be fattened on the mothers, and frequently, in consequence, allow a greater total number of fat lambs to be produced than would otherwise be the case. Thus the percentage of lambs sold as " stores " is reduced. There is ample evidence of this.

Under the improved conditions outlined there is the usual or greater quantity of winter feed for sheep. A greater and longer autumn growth, some and more winter growth, and a greater and earlier spring growth is obtained from improved and top-dressed pastures than from inferior ones. This additional growth in the " off " season may be such that, although sheep numbers may be very greatly increased, the provision of additional areas of winter supplementary feed such as turnips is unnecessary, though under these conditions hay or ensilage, or both, provide the reserve. An extra grass-feed supply in winter is often reflected in an increase in lambing percentage and lambing survival. An increased wool clip per sheep shorn is one of the first benefits of good pasture and adequate feed. It is not uncommon to have increases in lambing percentages of 5 per cent., 10 per cent., and even 15 per cent. The wool clip has been improved on several properties by 1½ lb. per sheep (and this half-bred wool, too). In one instance the clip per sheep has been raised from 7¼ lb. to 9¾ lb

On many foothill farms hogget mortality, due mainly to worms and malnutrition, is high. On one property, by the aid of clean, uncontaminated new pasture used for winter feed along with chaff and hay, hogget mortality has been reduced without drenching over a three-year period from 20 per cent. to 3 per cent. It is not claimed that the improved new pastures were in themselves responsible for this, but the policy of pasture renewal introduced four years ago allowed the hoggets to be grazed on clean feed. On other properties also significant reductions in hogget mortality have been secured.

All the above benefits, if not due directly to improved pastures in themselves, are distinctly associated with and very largely dependent upon practising a pasture-improvement policy. There is no other more economical method of securing on these areas the benefits outlined.

Financial Aspect.

On nearly all foothill farms there is a team or power unit used in the cultivation and cropping programme. The new policy that allows the proper sowing of grass does not usually entail any great increase in the area cultivated each year, but rather a rearrangement of the cropping rotation. There is, however, a little extra surface cultivation

for new permanent pasture. For a typical farm carrying 1,600 sheep the cropping under the old and the new methods might be compared in the following manner:—

	Old. Acres.	New (first few Years). Acres
Turnips and grass	80	..
Turnips	..	80
Rape and grass..	40	..
Rape	..	40
New permanent pasture	..	80
Green-feed oats and grass	40	..
Green-feed	40	40
Oats (for chaff)..	40	40
	240	280

There is really no significant extra team or power-unit costs for cultivation, the few extra acres being handled usually by the present units at more or less a fixed overhead charge. Grass-seeds may cost an extra 5s. to 10s. per acre, or even more, but this cost is offset by a reduced area being sown down and by a smaller seeds account for the saving of green-feed. The manurial costs are, however, increased, and at progressively greater annual cost as development (which includes top-dressing) proceeds This sometimes is partly offset by the sowing of permanent rye-grass for seed. Usually, however, top-dressing has to be reckoned as a direct charge against the benefits derived from growing improved pastures—a charge which is substantially offset by increased carrying-capacity, extra fat lambs, heavier wool clip, and so on.

Over the years, other things being equal, a policy of pasture improvement can only result in increased net returns. This has been demonstrated in practice by progressive and successful farmers. Where development, however, is more rapid than that permitted by the usual cropping programme, then, not only are seed and cultivation costs increased, but also proportionately larger numbers of ewe hoggets and four- and five-year-old ewes must be kept from sale, thus reducing receipts. At the same time manurial and top-dressing costs rise rapidly. Income from these improvements lags to some extent, and so trading accounts may show deficits while capital accounts for the same properties show improvements. Ready cash is usually needed for rapid development, which cannot be recommended unless capital expenditure and the long view are reckoned upon. Over-anxious and enthusiastic farmers sometimes develop their properties more rapidly than their resources make advisable.

WHY A PASTURE-IMPROVEMENT POLICY IS NOT AND HAS NOT BEEN GENERALLY ADOPTED.

Some explanation why grass is and has been sown in an unsatisfactory fashion with turnips, rape, and other supplementary crops now seems

necessary. Failure to adopt the practice of top-dressing when only poor pastures of a more or less temporary nature were available should need no comment.

The idea of a supplementary crop and a pasture being produced for the one and same cultivation and manurial cost has always appealed. Further, good permanent-pasture seed-mixtures, including true perennial rye-grass, have not been generally available, and thus, regardless of the method of sowing and subsequent treatment, the temporary rye-grass in the seed-mixture has quickly died out and left much bare ground for the establishment of inferior species. This rapid "running-out" has necessitated the renewal of large areas each year, with the result that pastures more or less have had to be sown every available opportunity—*i.e.*, with every supplementary crop—in an attempt to cope with the large areas awaiting the plough. This state of affairs has been characteristic of many farms, and unavoidable on those where temporary perennial rye-grass and red clover alone have constituted the pasture-seed mixture. As previously explained, the method of sowing also adds to the subsequent poorness and openness of the new pasture. Top-dressing on these areas has never been able to compensate for an unsuitable seed-mixture sown indifferently or otherwise.

The balanced-feeding value of turnips and grass and rape and grass is also an important factor favouring the sowing of grass with a supplementary crop. Progressive farmers, however, who are practising an improved grassing policy and cannot feed a good run-out of pasture, hay, or chaff, or both hay and chaff, along with their turnips usually sow with them ½ bushel per acre of Italian rye-grass. The turnips are grubbed in the usual fashion and the land ploughed for the sowing of new permanent grass in the approved method, regardless of the Italian rye-grass that may still be present.

An Example of Progress on a Foothill Farm.

A few particulars of progress and development under an improved grassing policy on a foothill farm should be of interest. The farm is situated near the Rakaia Gorge, on the Lake Coleridge road. The altitude is about 1,500 ft. Falls of snow in winter are often experienced. The area of the property is 800 acres, of which 60 acres are in plantations and 100 acres are in steep hilly tussock. The remainder comprises flats and gentle downs. A medium-quality loam grows natural pasturage of brown-top, sweet vernal, trefoil, &c., as well as some tussocks.

In 1932 turnips and grass were sown together and provided the winter feed as well as the new pasture. No fattening feed was grown at that time. The cropping last season—1935–36—consisted of 45 acres of turnips and swedes, 64 acres of new permanent pasture sown with ½ lb. rape per acre. In the past chaff has provided what winter reserve feed has been used. The total area sown to new pasture to date in the improved method is 130 acres. Particulars of stocking, sheep shorn, wool-yields, total death-rate (all sheep), and lambing percentages over a period of years are given in the table on following page.

Particulars of Stock Numbers, Sheep shorn, Wool-yield, Total Death-rate (all Sheep), and Lambing Percentages for Period 1930 to 1936.

Year.	Stock, 30th June. Sheep and Cattle.	Stock, 30th June. Sheep Units (1 Cattle Beast = 6 Sheep Units)	Sheep shorn.	Wool-yield per Sheep.	Total Death-rate in all Sheep	Lambing Percentage (calculated on Ewes put to Ram).
				Lb.	Per Cent.	Per Cent.
1930 ..	..	..	869	..	..	67
1931 ..	860 sheep, 57 cattle	1,202	751	6¾	6	72
1932 ..	856 sheep, 70 cattle	1,276	791	7¾	6	70
1933 ..	1,057 sheep, 7 cattle	1,099	939	7	13	66
1934 ..	1,100 sheep, 15 cattle	1,190	939	7¼	13	78
1935 ..	1,235 sheep, 17 cattle	1,356	925	9¼	8	86
1936 ..	1,632 sheep, 20 cattle	1,752	..	..	..	..

The first new pasture to be sown in the improved fashion after turnips consisted of 30 acres. It was sown in early November, 1933, with 35 lb. permanent rye-grass, 10 lb. cocksfoot, and 5 lb. red-clover seed per acre, and also 1 cwt. superphosphate per acre. Grazing was commenced in January, 1934. Top-dressing with 3 cwt. per acre of carbonate of lime in June, 1934, and 1 cwt. superphosphate per acre in early September, 1934, was carried out. It was also top-dressed in the autumns of 1935 and 1936 with 1 cwt. superphosphate per acre on each occasion.

The grazing-capacity as dry sheep per acre since establishment is given below by months:—

Year	January	February	March	April	May	June	July	August	September	October	November	December
1934 ..	7·63	14·50	9·20	8·90	3·59	..	..	..	0 70	5·20	-·30	1·40
1935 ..	9·70	11·30	3·10	6·00	1·09	4·54	..	1·47	1·21	4·21	5·60	10·57
1936 ..	6·77	0·28	7·24	2·20	1·89	..	..	..	..	..	..	..

The average number of dry sheep carried per acre for a period of thirty months was 4·43. This carrying-capacity is especially significant in view of the fact that the carrying-capacity of the farm as a whole prior to this winter has been only 1½ sheep per acre. The light grazing in November and December, 1934, was purposely carried out to allow of clover development as discussed earlier. Up to this last autumn, when some damage by grass-grub has been experienced, this particular pasture was a good dense sward with a low proportion of sweet vernal and some trefoil in association with the higher-producing species. Cocksfoot was not very prominent, but on this land volunteer white clover is excellent. So far brown-top is practically non-existent in this pasture.

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THE USE OF CONCENTRATES WITH FACTORY BUTTERMILK IN FATTENING BACON PIGS.

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It is well recognized that the addition of suitable concentrates to dairy by-products enhances considerably the nutritive value of the latter foodstuffs, but it is equally well recognized also that concentrates cannot be used, however desirable the practice may be from the nutritive point of view, if such use is not accompanied by a greater profit from pig-fattening than can be obtained from feeding dairy by-products alone. Accurate information upon the rates of meal-feeding with different types of meals and dairy by-products profitable to use at varying prices for meals and for the fattened product is not only very limited, but is also of importance.

Pig-fattening trials with dairy by-products have been carried out in many parts of the world, but unfortunately the results, in a very large measure, are not applicable to New Zealand because they nearly all relate to the minimum amounts of dairy by-products that can be used to advantage to supplement cereals, since in these countries, cereals are in abundant supply and dairy by-products are scarce. Throughout the major dairying and pig-raising districts our problem is exactly the opposite. It may be stated thus: What are the minimum amounts of meals which we can feed to advantage with maximum quantities of separated milk, buttermilk, and whey, the latter being our surplus foods and the former our scarce and therefore relatively expensive materials?

While it is certain that heavy meal-feeding at the rates shown to be desirable in other countries—viz., 2 lb. to 3 lb. per gallon of separated milk—are definitely unprofitable under our normal prevailing prices, it is possible that the limited use of concentrates may pay under favourable conditions. Current farming practice supports this view, and, where meals are employed, the quantities used are normally extremely small relative to the ration of dairy by-products fed. Thus the rate may vary from 1 part of meal to 30 parts up to 100 parts of by-product as compared with the Danish system of feeding where the rate is commonly from 1 to 2 parts of meal to 1 part of by-product. Due largely to the paucity of information on the subject, little uniformity of practice exists even amongst farmers using concentrates; while a large number confine their attention to the utilization of dairy by-products alone.

It is important that the subject cannot be decided wholly upon the relationship of the price of meals to the price of pork and bacon. Thus factory whey is of little value alone as a fattening food, being deficient in essential flesh-forming constituents. Supplementing with minimum quantities of suitable concentrates to make good this deficiency is essential before whey can be utilized adequately in pig-fattening at all. Further, even on the economic side, the problem is no simple one. While it is possible in carefully controlled feeding trials to compare the relative cash returns from dairy by-products used alone and from dairy by-products used

with meals in various quantities and varying types, such results do not present a complete picture of the financial results of supplementing with meals. The feeding of meals possesses certain advantages, the precise financial effects of which are impossible to estimate with accuracy. The time taken to fatten a pig enters largely into the question for various reasons :—

(*a*) Even small amounts enhance the value of the by-product fed. Although the daily consumption of milk is not reduced by a low plane of meal-feeding, the total fattening period is reduced, and a saving effected in the total amount of milk required per pig. This results in a greater turnover and a quicker turnover, both of which affect production-costs by reducing the overhead charges on each pig fattened.

(*b*) This shortening of the fattening period by the limited use of concentrates may be of particular value when milk-supplies fall at the end of the season, by allowing of profitable marketing of pigs that otherwise would have to be specially handled either by carry-over in the winter or marketing at low weights of inferior quality In this way the judicious use of meals may play a definite part in the successful fattening of two litters per year—a practice often impossible on milk alone, yet one essential for low overhead costs

(*c*) It frequently happens that prices of pig-meat fall at certain periods of the year, or that a fall of price is anticipated If the farmer can adopt a system by which he can produce an accelerated rate of growth it often pays him to do so, though ordinarily that system of feeding may not be profitable.

These points should be kept in mind when examining the results of the feeding trials herein described. These trials have been designed primarily to investigate the economic aspects of the use of concentrate meals as supplements. The financial results for the reasons set out above underestimate rather than overestimate the case for meal-supplementing in pig-fattening

A further important aspect of meal-supplementing which has been investigated coincident with the economic side, has been the effect of the use of limited amounts of meals upon the commercial quality of the bacon carcass. Quality in the finished product is such an important factor to-day in profitable production that any feed trial designed to provide data upon the relative merits of various methods must consider the carcass quality. Moreover, much of the criticism of the quality of our export baconers by the British market has been attributed to the system of feeding, and numerous suggestions have been made from time to time by responsible authorities that considerable improvement would result from the greater use of concentrates along with our dairy by-products The data collected in this connection will be the subject of a separate paper

TECHNIQUE EMPLOYED.

All trials have been conducted by the "Group" method. The various groups in any one series have been composed of pigs of known breeding and comparable pre-weaning history, selected shortly after

weaning, and evenly "balanced" between the various groups according to breed, breeding, initial live-weight, age, and sex. All groups in any one series are comparable in these respects. Care has been taken to ensure similar housing, pen accommodation, and general management in feeding for all groups, the only difference being the actual rations employed. The quantity of milk fed has in all cases been governed by the appetite of the pigs—the quantity which each group would clean up readily when fed three times daily. In meal-supplemented groups, the concentrates have been fed at the morning and evening feed in equal amounts. All feed has been accurately measured. Initial live-weights have been taken before feeding in the morning after an all-night fast. Every pig has been carried to approximately the same final dressed carcass weight—viz., 140 lb.—by removal from the experiment for slaughter when a live-weight of approximately 200 lb. has been reached. Economic results have been based upon the food required to produce 100 lb of dressed-weight gain. This has been calculated from the actual final dressed weight obtained on slaughter, and the "initial" dressed weight, obtained by deducting an amount for offal of 33⅓ per cent. from the initial live-weight. This system has been adopted in preference to stating results in terms of live-weight. Pigs are paid for on a dressed-weight basis, and the data have therefore a direct bearing upon cash returns. Live-weight is not so useful in this respect, and, in addition, is very difficult to ascertain with accuracy owing to the many factors not under control affecting it. The writer's experience over several years of pig-feeding trials has indicated the use of live-weights to be associated with material difficulties, particularly when the greater part of the rations fed is composed of liquids, and despite the possibility of error introduced by estimating "initial dressed weight," the use of dressed weight is likely to be associated with greater accuracy.

After slaughter the commercial quality of each carcass has been carefully examined, and subsequently, in the majority of cases, the pigs have been shipped to London for examination and report by English experts.

It must be noted that the trials reported in this paper cover the use of factory buttermilk; trials using separated milk and whey will be the subject of a separate report. While the results outlined are thus not strictly applicable in detail to the use of separated milk, it is fairly safe to assume that they have a general bearing on the use of the latter material, as the two foodstuffs are similar in type. Information from trials with separated milk so far available lends support to such a view.

SERIES A.

THE USE OF DIFFERENT TYPES OF MEAL OVER THE WEANER-BACONER WEIGHT RANGE.

Forty-four Tamworth-Berkshire first-cross pigs from recorded litters were evenly balanced into four groups, each of 11 pigs. All pigs were by the same sire, and were placed under trial when twelve weeks old. During the pre-weaning period, and for the month thereafter, all had received limited daily rations of a cereal meal amounting to ¼ lb. to ½ lb. per pig daily, in addition to buttermilk. The rations of each group during the progress of the trial were as follows:—

Group 1—Control: Factory buttermilk only.

Group 2—Meat-meal*: Factory buttermilk plus ½ lb. of meat-meal per pig daily.

Group 3—Meat-meal and pollard†: Factory buttermilk plus ¼ lb. meat-meal plus ½ lb. pollard per pig daily.

Group 4—Cereal-meal‡: Factory buttermilk plus ¾ lb. cereal-meal per pig daily.

GROWTH-RATE AND FOOD-CONSUMPTION RESULTS.

The growth-rate and food-consumption results are set out in Table 1:—

Table 1.—Series A: Effect of varying Types of Meal Supplements.

——	Group 1 Control—Milk only	Group 2 ½ lb Meat-meal	Group 3 ¼ lb Meat-meal, ½ lb Pollard	Group 4 ¾ lb Cereal-meal.
		Growth-rate.		
* Initial weight	486 lb	396 lb.	366 lb	360 lb.
Average	44·2 lb.	36 lb.	33·2 lb.	33 lb.
† Final weight	1,603 lb	1,563 lb	1,564 lb	1,570 lb.
Average	145·7 lb.	142 lb.	142·2 lb	143 lb.
* Total gains	1,117 lb	1,167 lb	1,198 lb	1,210 lb
Average	101·6 lb.	106 lb	109 lb	110 lb
Average days on trial ..	123	120	120	113
Average daily weight-gain	0·82 lb	0·88 lb	0·91 lb.	0·96 lb.
		Food-consumption.		
Total—				
Buttermilk	7,980 gals	7,480 gals	7,480 gals.	6,710 gals.
Meat-meal	..	653 lb	326 lb	..
Pollard	..	..	653 lb	..
Cereal-meal	..	..	..	1,026 lb.
Per 100 lb gain of dressed weight—				
Buttermilk	714 gals	641 gals	624 gals	555 gals.
Meat-meal	..	56 lb	27 lb	..
Pollard	..	..	54 lb	..
Cereal-meal	..	..	..	84·8 lb

* Dressed weight calculated. † Dressed weight actual

It will be observed from the above that in every case the meal-supplemented pigs consumed less buttermilk in the production of 100 lb. of dressed-weight gain, fattened at a greater rate, and, in consequence, required less time to make marketable weight than the pigs fed buttermilk alone. At the same time the control group put up a good performance, the figure, 700 gallons of buttermilk per 100 lb. dressed-weight gain being of considerable interest in indicating the value of this dairy by-product in pig-fattening.

Of the three types of concentrate used, Cereal-meal (Group 4) gave the best results on a food-consumption and growth-rate basis. It will be noted that in this group the feeding of approximately 85 lb. of cereal-meal per 100 lb. of meat produced resulted in a saving of

* Meat-meal; pure meat-meal, 60 per cent to 65 per cent. crude protein, 10 per cent. fat † Pollard. New Zealand commercial sample ‡ Cereal-meal; mixture of 55 per cent. barley-meal, 10 per cent. pea-meal, 20 per cent pollard, 5 per cent. maize-meal, 10 per cent. meat-meal.

160 gallons of buttermilk as compared with the control group for the same increase in weight. This is equivalent to a saving of 22 per cent. in milk-requirement. Similarly Group 3 gave a saving of 12·5 per cent. and Group 2 of 10 per cent. of buttermilk over the amount required when used alone.

ECONOMY RESULTS.

Table 2 sets out the respective cash returns in pence per 100 gallons of buttermilk fed under the four systems. These have been calculated for varying bacon and meal prices, the cost of the meal used having been deducted from the gross returns in the case of the meal-fed groups the balance only being credited to the buttermilk used.

Table 2.—Series A. Cash Returns per 100 Gallons Buttermilk (deducting Cost of Meals).

——	Group 2 Meat-meal			Group 3 Meat-meal and Pollard			Group 4. Cereal-meal		
Bacon price per pound	4d	5d.	6d	4d	5d	6d.	4d	5d	6d
Control buttermilk only	56d	70d	84d	56d	70d	84d	56d	70d	84d
Meal at £6 per ton	56 0d	71 9d	87 5d	54 8d	70 8d	86 8d	61 0d	79 0d	97 0d
Meal at £8 per ton	54 0d	69 7d	85 6d	51 6d	67 6d	83 6d	57 4d	75 4d	93 4d
Meal at £10 per ton	52 0d	67 7d	83 3d	48 6d	64 6d	80 6d	53 8d	71 8d.	89 8d
Meal at £12 per ton	50 0d.	65 6d	81 2d	45 5d	61 5d	77 5d	50 2d	68 2d	86 2d.

The intimate dependence of the economy of meal-supplementing upon the bacon-meal price relationship can be seen from the data presented in this table. With meal costing £6 per ton and bacon worth 5d. per pound all three meal groups show greater cash returns than the control group. When the price of bacon falls to 4d. per pound, however, Group 3 becomes unprofitable. A rise in meal price to £10 per ton leaves Group 4 only showing a greater cash return per 100 gallons of milk, and this only when bacon is worth 5d per pound or more.

As indicated previously, it must be remembered that these figures understate the financial returns from the use of meal; the lower overhead costs possible as a result of the saving in milk and fattening time must be credited to the meal-feeding systems. The precise effect in this connection unfortunately cannot be assessed from the data available from this experiment. It is likely to be considerable, however, as witness in Group 4 where the 20-per-cent. saving in milk would permit six pigs to be fattened to bacon weights under this system of feeding for every five fattened using buttermilk alone. The saving of ten days per pig in time will also affect cash returns under average conditions. These points are of great importance, particularly since on the majority of dairy-farms the seasonal supply of dairy by-products introduces severe difficulties relative to fattening when milk-supplies fall towards the end of the season and unfinished pigs in large numbers still remain to be marketed. The exact effects of these factors in practice are intimately bound up with management generally, and are capable of measurement only by examining farm pig-raising operations as a whole. In this connection it is of direct interest to note in a recent survey of pig-management on Manawatu farms* where the whole pig-keeping

* Management of Pigs on Dairy-farms. *N.Z. Journal of Agriculture*, July, 1936.

operations came under review showed higher net cash returns per pound of butterfat in favour of farms using meal concentrates at similar rates to those employed in this trial, even although experimentally the margin of profit appears to be small. It is considered that the influence of the factors mentioned above played a definite and material part in producing this result.

Though therefore subject to the disadvantage of underestimating the case for meal-supplementing, the figures arising from the foregoing trial are of considerable interest, and do indicate the approximate prices at which meals would have to be purchased, and the prices which would need to be received for bacon, for the use of supplements to be profitable at the rates employed Table 3 sets out the position in this connection more clearly.

Table 3—Series A : Profitable Meal Price - Bacon Price Ratio

Price of Bacon =	4d. per Pound			5d per Pound			6d per Pound			Per Pound
	£	s	d	£	s	d.	£	s	d	
Group 2 ..	6	0	0	7	10	0	9	0	0	= Price of meal per ton *
Group 3 ..	5	0	0	6	0	0	7	0	0	= Price of meal per ton
Group 4 ..	9	0	0	11	0	0	13	0	0	= Price of meal per ton.

* Per ton of 2,000 lb.

This table gives the price per ton for meal at which the cash return from buttermilk approximately equals the return when the latter is used without meal Thus, in Group 4, cereal-meal would have to be bought at £11 per ton or less when bacon is worth 5d. per pound in order for this system of feeding to show a profit margin With bacon at 5d., the pollard-meat-meal mixture of Group 3 would need to be bought at £6 per ton or less, and the meat-meal of Group 2 at £7 10s. or less.

SERIES B

Use of Cereal-meal at varying Rates over the Porker-baconer Weight Range

Following the trial described above, the following was laid down to investigate the effect of varying the rate of meal-supplementing. In Series A different types of concentrate fed at similar rates were compared. Cereal-meal having given the best result was selected as the concentrate, and three groups each of twelve pigs were taken and evenly balanced as previously indicated. The pigs were of similar breeding to those of Series A, but were heavier at the commencement of the trial, averaging approximately 80 lb. dressed weight, as compared with 40 lb. dressed weight in Series A. This trial thus covers what may be termed the "porker-baconer" weight range as distinct from the first trial which covered the "weaner-baconer" weight range. The rations of the different groups were as follows :—

Group 1—Control : Factory buttermilk only.
Group 2—Light meal : Factory buttermilk plus ¾ lb. cereal-meal per 100 lb. live-weight per day.
Group 3—Medium meal : Factory buttermilk plus 1½ lb. cereal-meal per 100 lb. live-weight per day.

A variation in the method of rationing the meal might be noted. In Series A the meal was employed at the same rates per pig per day throughout the trial. In Series B the rate varied with the growth of the pigs, the amount increasing with increased weight. The pigs were weighed fortnightly, and the meal ration adjusted according to the gross weight of each group on the basis indicated above. General methods of feeding, housing, and pen accommodation were similar to the conditions operating for Series A.

GROWTH-RATE AND FOOD-CONSUMPTION RESULTS.

The growth-rate and food-consumption results are set out in Table 4.

Table 4.—Series B : Effect of varying the Rate of Supplementing.

—	Group 1: Milk only (Control.)	Group 2: Milk + ¾ lb. Cereal-meal	Group 3: Milk + 1½ lb. Cereal-meal.
Growth-rate.			
* Initial weight	1,000 lb.	1,007 lb.	1,001 lb.
Average	83·3 lb.	84 lb.	83·3 lb.
† Final weight	1,610 lb.	1,642 lb.	1,678 lb.
Average	134 lb.	137 lb.	140 lb.
* Gain in weight	601 lb.	635 lb.	678 lb.
Average	50 lb.	53 lb.	56·5 lb.
Average days on trial	62·0	55·5	49·5
Average daily weight-gain	0·80 lb.	0·95 lb.	1·14 lb.
Food-consumption.			
Total—			
Buttermilk	5,267 gals.	4,367 gals.	4,082 gals.
Cereal-meal	..	837 lb.	1,390 lb.
Per 100 lb. gain of dressed weight—			
Buttermilk	876 gals.	687·7 gals.	602 gals.
Cereal-meal	..	132 lb.	205 lb.

* Dressed weight calculated. † Dressed weight actual.

Again less buttermilk was consumed by the meal-supplemented groups per 100 lb. of dressed weight produced, and a greater rate of fattening maintained than on buttermilk alone. Supplementing at the 1½ lb. rate gave a greater saving in milk and time than supplementing at the ¾ lb. rate, but it is of interest to note that the saving in milk was not directly proportional to the increased amount of meal used. That is, Group 2, using only half as much meal saved 21·5 per cent. milk, as compared with Group 3 (31·2 per cent.). The saving in time amounted to six days and a half and twelve days and a half per pig respectively. This effect of a lower proportional increase in efficiency with heavier rates of meal-supplementing is in keeping with similar results of numerous trials carried out by the writer with both separated milk and whey under similar conditions ; small quantities of meal though producing a smaller gross effect produce a greater proportional effect than larger quantities.

As compared with the results of Series A, the greater amounts of food required to produce 100 lb. of pig-meat in this series are of considerable interest. Thus, comparing Groups 1 and 4 of Series A with Groups 1 and 2 of Series B shows that significantly more buttermilk

was required for the production of the same amount of increased weight in the buttermilk-alone groups, and more buttermilk plus meal in the meal-fed groups, *i.e.*,—

Series A: Weight range 40 lb. to 140 lb. required 714 gallons milk, or 555 gallons milk plus 84 lb. meal, per 100 lb. pig-meat produced.

Series B: Weight range 90 lb. to 140 lb. required 876 gallons buttermilk, or 688 gallons milk plus 132 lb. meal, per 100 lb. of pig-meat produced.

While the two series are not strictly comparable, the only material difference between the groups compared above is the weight-range over which they extended, and, although the trials were not designed to investigate the point, the results are so striking as to indicate that the weight-range factor has probably been largely responsible for the difference in the economy of food noted. Such a result is consistent with the fact that small animals have a lower maintenance requirement than large animals, and in consequence a larger proportion of the ration of the former is available for conversion into increased weight.

ECONOMY RESULTS.

Table 5 sets out the economic results on a cash return per 100 gallons of buttermilk basis. Costs of meal used have been deducted in the case of the meal-supplemented groups, the balance only being credited to the buttermilk used.

Table 5.—Series B. Cash Returns per 100 Gallons Buttermilk (deducting Cost of Meals).

——	Group 2 ¾ lb Meal			Group 3 1½ lb Meal		
Bacon, price per pound	4d	5d	6d.	4d	5d.	6d
Control, buttermilk alone	45 5d	57 0d	68 4d	45 5d	57 0d	68 4d
Meal at £6 per ton ..	44·4d	58·9d	73·4d	43 0d	59·8d	76·7d
Meal at £8 per ton .	39·8d	54·3d	68·8d	34·7d	51·6d	68·4d.
Meal at £10 per ton ..	35·2d	49·7d	63·2d	26·6d	43·5d	60·4d.
Meal at £12 per ton .	30·6d	45·1d	58·6d	18·4d	35·3d	58 2d.

The most significant feature arising from these results is the fact that only at higher prices for bacon and at lower prices for meal than those normally ruling in New Zealand was there a margin of profit over the control group fed on buttermilk alone. Meals can seldom be purchased at £6 per ton, while the price of bacon is normally well below 6d. per pound the relative prices which would need to exist for a profit margin from meal-supplementing as in Group 2. A slightly higher price could be paid for meal as used in Group 3 if bacon is worth 6d. per pound. The low efficiency of food-consumption of the pigs in this series would appear to be partly responsible for this result, and if this be so it throws considerable doubt on the wisdom of the common practice of pig-fatteners in using meals during the later stages of growth of pigs rather than during the early stages. "Topping off" on meal would appear to be a questionable practice on a profit basis under normal prices.

In so far as the two rates of supplementing are concerned, the results of this series show that supplementing at the lighter rate was productive of greater cash returns than supplementing at the heavier rate at normal price-levels; both, however, were unprofitable compared with control. This feature of a smaller loss at price-levels at which a loss exists, and a smaller profit at prices conducive to a surplus, associated with the lighter rate of supplementing as compared with the heavier rate is a characteristic feature of the effect of different planes of supplementary feeding, and from a practical point of view means that under New Zealand prices where the meal-bacon price ratio is unfavourable to any extensive profitable use of concentrates feeding of small quantities is a less risky practice than the use of medium to heavy quantities.

SERIES C.

EFFECT OF MEAL-SUPPLEMENTING OVER VARYING WEIGHT RANGES.

In order to investigate further the possible effect suggested from the results of Series A and B of the range of growth over which meal supplements are used upon the economy of food-consumption and upon the cash returns from by-products, a third series of trials designed for the purpose have been completed. These also provide additional data on the general problems of meal-utilization. Five groups each of eight first-cross Tamworth-Berkshire pigs were taken. All pigs were of similar breeding to those used in the first two series, and had a similar pre-weaning history. The trial extended over the weaner-baconer weight range, but the stages of growth during which meal was used as a supplement to the milk ration varied. Feeding, housing, and pen accommodation conditions were comparable for each group, and similar to those of the previous trials. The respective rations were as follows:—

Group 1.—Control: Buttermilk only.

Group 2.—Meal, weaner-porker (whole period): Buttermilk plus 1 lb. of meal per 100 lb. live-weight per day over whole fattening period.

Group 3.—Meal, weaner-porker (early period): Buttermilk plus 1 lb. of meal per 100 lb. live-weight per day from 50 lb. to 120 lb. live-weight, thereafter to 200 lb. live-weight, buttermilk only.

Group 4.—Meal, heavy to porker, light, porker to baconer (heavy early, light late period): Buttermilk plus 2 lb. meal per 100 lb. live-weight per day from 50 lb. to 120 lb. live-weight, 1 lb. meal thereafter to 200 lb. live-weight.

Group 5.—Meal, porker to baconer (late period): Buttermilk plus 1 lb. meal per 190 lb. live-weight per day from 120 lb. to 200 lb. live-weight. From 50 lb. to 120 lb. live-weight, buttermilk alone.

The buttermilk was fed three times daily in quantities which the pigs readily consumed. The meal was fed with the milk at the morning and evening feed. It will be noted that the rations given cover the use of meal as a supplement during the whole period, during the early period, and during the late period of fattening, as well as introducing the modification of feeding at a heavy rate during the early stages, and at half this rate thereafter. The meal used was in all cases cereal-meal as used in the previous trials.

FOOD-CONSUMPTION AND GROWTH-RATE RESULTS.

Table 6 sets out the growth-rate and economy of food-consumption results calculated on a dressed-weight basis.

Table 6.—Series C Effect of Supplementing over varying Weight Ranges

—	Group 1 Control	Group 2	Group 3	Group 4	Group 5
			Growth-rate		
* Initial weight	272 lb.	276 lb	283 lb	284 lb	274 lb.
Average . .	34 lb	34.5 lb	35.4 lb	35.5 lb	34·2 lb
† Final weight .. .	1,167 lb	1,195 lb	1,166 lb.	1,138 lb	1,175 lb
Average	146 lb.	149 lb.	146 lb.	142 lb.	147 lb.
* Gain in weight	895 lb	919 lb	883 lb	854 lb	901 lb
Average	112 lb	115 lb	110.4 lb	107 lb	112.6 lb
Average days on trial	187½	170	177½	155½	173
* Average daily weight-gain	0.59 lb	0.67 lb.	0.63 lb	0·69 lb	0.65 lb
		Food-consumption			
Total—					
Buttermilk ..	7,520 gals	5,459 gals.	6,578 gals	4,304 gals	6,217 gals
Meal	.	1,109 lb	349 lb	1,366 lb	768 lb
Per 100 lb gain of dressed weight—					
Buttermilk .	840 gals	594 gals.	745 gals	504 gals	690 gals
Meal ..		120 lb	40 lb	160 lb	85 lb

* Dressed weight calculated from live weight † Actual cold dressed weight

Examination of the results in Table 6 will indicate that the growth-rate and fattening-time of the respective groups was in keeping with the amounts of meal fed, groups receiving the larger quantities fattening at a faster rate. It will also be noted that the growth-rate of all groups was lower than that obtaining in the previous trials. This effect is considered to be due to the more severe climatic conditions existing during the progress of this series. Weather was markedly colder, and rainfall abnormally higher for the season as compared with the conditions obtaining during the previous series. With pigs fattened out-of-doors it was only to be expected therefore that growth would be slower. This lower efficiency in growth-rate was similarly carried to economy of food-consumption, each group showing a higher food requirement for the production of 100 lb. of dressed-weight gain than in Series A, where the trial covered a similar growth-range.

The relative efficiency of the different systems of supplementing can be more clearly seen from Table 7, where the relative amounts of meal fed and milk saved per 100 lb. of pig-meat produced allow the milk saved per pound of meal fed to be calculated (Column 5).

Table 7.—Series C: Efficiency of Meal-utilization

No. of Group.	Meal used per 100 lb Gain.*	Milk saved per 100 lb Gain	Milk saved.	Days saved per Pig	Milk saved per Pound Meal used
	(1.)	(2.)	(3.)	(4.)	(5.)
	Lb.	Gals.	Per Cent.		Gals.
Group 2	120	246	29·3	17½	2·00
Group 3	40	95	11·4	10	2·37
Group 4	160	336	40·0	32	2·10
Group 5	85	150	18·0	14½	1·77

* Dressed weight.

From the figures in Column 5, Table 7, it appears clear that the efficiency of meal-utilization is greater when concentrates are fed over the early stages of growth than over the later stages. A high level of efficiency is also apparent when they are employed so as to take advantage of the greater efficiency of food-utilization of the pig at young stages of growth, by being fed throughout the whole fattening-period. Thus Group 3, where the meal was fed up to porker weights only, thereafter being discontinued, shows the highest efficiency, with 2·37 gallons of milk saved per pound of meal fed. Group 4, where a heavy rate of feeding occurred up to pork weights, followed by a lighter rate to bacon weights, shows up well with a slight advantage over Group 2, where meal was fed at the same rate throughout. In both these cases 1 lb. of meal saved approximately 2 gallons of buttermilk. Feeding meal from pork to bacon weights only produced the least efficient results, 1 lb. of meal saving 1·77 gallons of milk (Group 5).

A further significant feature from these results is the fact that, although Group 3 shows the maximum efficiency of utilization, the gross effect is small, as indicated by the total amount of milk saved of 11 per cent. as compared with a saving of 40 per cent. in Group 4 and 30 per cent. in Group 2. This is due to the small total quantity of meal fed, as must be the case when it is employed in such limited quantities to small pigs. This point is of practical significance: while the feeding of meal during the early stages of fattening only would appear to result in the most efficient utilization per pound of meal fed, the total effect on milk-reduction is small. A system of feeding as in Groups 2 and 4 which takes advantage of the former point but which, in addition, through the use of a greater total quantity of meal, produces a far greater gross effect in milk-saving and fattening-time, would appear to be the better method of feeding. The results are also suggestive that a still heavier rate of supplementing during the early stages only might be advantageous.

ECONOMY OF RESULTS.

The relative cash returns per 100 gallons of buttermilk are set out in Table 8 for various prices for bacon and meal.

Table 8.—Series C: Cash Returns per 100 Gallons Buttermilk (deducting Cost of Meals).

—	Group 2.			Group 3.			Group 4.			Group 5.		
Price of Bacon ..	4d	5d.	6d	4d.	5d.	6d.	4d.	5d.	6d	4d.	5d.	6d.
Control group ..	47·5d.	59·5d.	71·5d.	47·5d.	59·5d.	71·5d.	47·5d.	59·5d.	71·5d	47·5d.	59·5d	71·5d.
Meal at £6 ton ..	53·0d.	70 0d	86·5d.	49 8d.	63 0d.	76·5d	56·5d.	76·5d.	96·0d.	49·0d.	63·5d.	78·0d.
Meal at £8 ton ..	48·0d.	65 0d	81·5d.	48·5d.	61·7d.	75 2d.	48·5d.	68·5d.	88 0d.	45·0d.	58·5d.	73·0d.
Meal at £10 ton .	43·0d.	60 0d.	76 5d.	47 2d.	60·4d.	73·9d	40 5d	60·5d.	80·0d.	40·0d.	53·5d.	68·0d.
Meal at £12 ton ..	38·0d.	55 0d	71·5d.	45·9d.	59·1d.	72 6d.	32·5d	52·5d.	72·0d.	35·0d.	48·5d.	63·0d.

It will be noted that at 4d. per pound for bacon all groups show a profit margin over the use of buttermilk alone providing meal costs £6 per ton or less. When the price of meal rises to £8 per ton, however, Group 5 becomes unprofitable with bacon worth 4d. per pound. At £10 per ton for meal Group 5 becomes unprofitable even with bacon worth as much as 6d. per pound, while the remaining three groups are still profitable even with bacon returning 5d. per pound. With meal costing £12 per ton Group 3 is still profitable at 5d. per pound, while Group 4 shows a margin at 6d. per pound. These results are in line with the efficiency of meal-utilization, Group 3, using meal during the early stages only, being profitable at higher meal prices and lower bacon prices than any of the other systems of feeding.

It is important, however, that although the Group 3 system of supplementing is profitable at higher prices for meal and at lower bacon prices the margin of profit is small, due, as already emphasized, to the small total quantity of meal used. Group 4 system shows to outstanding advantage in this respect Although unprofitable price-levels are reached sooner than in the case of Group 3, the margin of profit when a profit is obtainable is far greater. It is also evident that Group 5 system on a cash return per 100 gallons of milk basis has little to recommend it, being productive of a definite loss at normal price-levels.

It must further be emphasized that if the saving in milk and fattening-time be taken into account the advantages shown in these respects by Groups 2 and 4 give them a still greater advantage on the profit side over the other systems of supplementing. Table 9 sets out the prices at which meals must be purchased by the farmer for the various systems of feeding used in this trial to show a cash surplus over the use of buttermilk alone.

Table 9.—Series C. Profitable Meal Price - Bacon Price Ratio

Price of Bacon	4d per Pound	5d per Pound	6d per Pound	
	£ s d	£ s d	£ s d	
Group 2	8 0 0	10 0 0	12 0 0	= Meal price per ton
Group 3 . .	10 0 0	12 0 0	14 0 0	= Meal price per ton
Group 4 .. .	8 0 0	10 0 0	12 0 0	Meal price per ton.
Group 5	7 0 0	8 0 0	9 0 0	Meal price per ton

From Tables 8 and 9 it would appear that feeding as in Group 2 or as in Group 4 offers the most attractive systems of fattening with the use of supplements so far as the growth-range factor is concerned. With the latter where 2 lb. of concentrate per 100 lb. live-weight per day was fed up to porker weights (120 lb. live-weight) and 1 lb. thereafter to bacon weights (200 lb. live-weight), as much as £12 per ton could be paid for meal when bacon is worth 5d. per pound. Remembering that this system also saved 40 per cent. in the amount of milk required to fatten a pig and over one month per pig in fattening-time, the large increase in turnover and more rapid output thereby possible should result in a worth-while profit margin in favour of this method of meal-utilization and as compared with using milk alone.

RELATIONSHIP OF THE RESULTS OF THESE TRIALS WITH PRACTICE.

The results of the three series of trials reported in this paper emphasize that the whole question of meal-supplementing is no simple one, and its profitableness is intimately bound up with the relationship of meal and bacon prices and with the system of utilization followed.

The first point emphasizes that, so little is the margin of profit at average prices and with common methods of feeding, either more will have to be received for the product or less paid for the concentrates before meal-supplementing can play any extensive part in the industry.

Bearing this fact in mind, the second point becomes of even greater significance. With a small margin only available, the actual method of supplementing must be closely watched, and in this connection the trials completed emphasize that the type of concentrate, the quantity used, and the stage of growth over which it is used are three important factors likely to affect the profitableness of any meal-feeding programme. It is suggested, therefore, for the guidance of farmers that—

(*a*) The amount of meal concentrates used should be limited to 100 lb. to 150 lb of meal for every 100 lb. of dressed meat produced. This can be secured by feeding at the rate of 1 lb. to 1½ lb. per 100 lb live-weight per day.

(*b*) That the concentrates be used at the above rates when meal is procurable at from £8 to £10 per ton when bacon is worth 4d. to 5d. per pound.

(*c*) That the concentrates should be fed particularly during the early stages of growth and advisedly at a heavier rate during the early stages than during the later stages.

(*d*) That "topping off" pigs on meal as a regular practice be avoided; that this should be employed only when essential as an aid to marketing unfattened pigs when milk-supplies alone are in inadequate supply

VALUE OF BUTTERMILK IN PIG-FATTENING.

One further aspect of interest arising from the trials is the data obtained upon the fattening-value, in the production of bacon pigs, of factory buttermilk, a by-product which is available in considerable quantities in New Zealand. With a production of some 150,000 tons of butter, approximately 45,000,000 gallons of this foodstuff is available annually for conversion into pig-meat

The figures show that between 700 and 800 gallons of buttermilk produced 100 lb. of dressed pig-meat in pigs fattened from the weaning stage to bacon weights. Expressed another way, 100 gallons produced 13·3 lb. of bacon (dressed pig-meat). Theoretically, the manufacture of 1 ton of butter should result in the output of approximately 1 ton or 200 gallons of buttermilk. In actual practice the yield is nearer 300 gallons per ton of butter, due to the addition of water during the manufacture process. It might be noted that it is this added water which is probably largely responsible for the lower food-value shown by the buttermilk as compared with skim-milk, which it closely resembles in composition. The latter material yields under comparable conditions 100 lb. of dressed-weight gain from 500 gallons.

On a basis of a yield of 300 gallons of buttermilk per ton of butter, the possible yield of pig-flesh per ton of butter should be approximately 40 lb. of dressed weight. This figure should prove useful as a guide

to the cash value of this by-product under any given set of conditions—*i.e.*, at 4d. per pound for pig-meat buttermilk should have a gross cash value under average management conditions of 13s. 4d. per ton of butter. Note that the figure is merely indicative of *gross* cash value; all incidental costs of production, which are many and variable, must be taken into account in estimating the probable *net* cash value should the data be used by farmers tendering for factory buttermilk outputs or by factories contemplating the installation of their own pig-fattening equipment.

ACKNOWLEDGMENTS.

The thanks of the writer are due to the directors of the Cheltenham Dairy Co. for permission to use their pig-farm for the work and for generous donations, and to the manager of the farm, Mr. H. E. Thurston, for the many facilities provided and for his efficient handling of the feeding and management of the pigs. Appreciation is expressed also to Professor W. Riddet for advice in designing the trials and preparing this report, and to Mr. W J. Croucher, Recording Officer of the Manawatu-Oroua Pig-recording and Development Club, under whose auspices the work was carried out, for generous assistance during the progress of the trials Thanks are also due to the Meat Producers Board, the financial assistance of which made the work possible.

DAIRY-HERD TESTING IN NEW ZEALAND.

REVIEW OF THE 1935 36 SEASON

W. M. SINGLETON, Director of the Dairy Division, Department of Agriculture, Wellington

REORGANIZATION.

ON the 27th February, 1936, an Order in Council was gazetted bringing the future control of group herd-testing under the New Zealand Dairy Produce Board, provision being made for the new organization to function as from the 1st April, 1936.

Prior to this new arrangement the only control of the work was that provided by the restricted authority of the Dominion Group Herd Testing Federation, essentially a voluntary organization and without statutory power.

Under the new arrangement the Dairy Board has power to regulate and control the group herd-testing system and the calf-marking schemes associated therewith. It is now compulsory for all group organizations to register with the Board and to abide by rules laid down by the Board, and no association is permitted to operate without the sanction of the Board.

The actual supervisory work is being done by a committee of the Board. The Herd-testing Central Executive has been replaced by what is known as a Herd-recording Council. The Dominion Group Herd Testing Federation has ceased to function, except from the point of view of periodic meetings and the selection of representatives for appointment to the Herd-recording Council. Mr. C. M. Hume, previously Federation Supervisor of Herd-testing, is Officer in Charge of the work under the Dairy Board.

So far as finance is concerned, the Government has agreed to make certain annual grants until 1941, at which time the matter is to come up for review in the expectation that the Dairy Board will thereafter provide the whole of the necessary finance. During the financial year 1935-36 the sum of £4,000 was expended by way of Government subsidy to herd-testing.

At this stage, which marks the beginning of a new period in the history of New Zealand's dairy-herd-testing movement, it is appropriate to take a glance at the period which has just closed, and which commenced with the introduction of the group system in 1922, though the year 1928 should also be noted as the date from which the Government granted an annual subsidy to herd-testing.

The following table enables a survey of the general position during the period referred to from the point of view of number and percentage of herd cows tested under the group and association systems :—

Table 1.

Season.	Tested Cows.	Tested Cows expressed as Percentages of Total Cows in Milk
1922-23 ..	84,825	7·5
1923-24 ..	151,214	12·7
1924-25 ..	196,850	16·5
1925-26 ..	169,776	14·4
1926-27 ..	170,150	14·4
1927-28 ..	224,130	18·0
1928-29 ..	259,594	20·1
1929-30 ..	283,731	20·4
1930-31 ..	271,404	18·0
1931-32 ..	259,857	16·4
1932-33 ..	286,054	16·6
1933-34 ..	297,647	16·4
1934-35 ..	265,944	14·5
1935-36 ..	245,355	13·5

In a broad summing-up, and making due allowance for influencing factors, the net result of the effort and expenditure of the past fourteen years must be regarded as disappointing. Between 1922 and 1927, when the group herd-test was being built up, herd-testing showed marked development. The Government subsidy appears to have had a favourable though merely temporary effect, creating a further upward trend to 1928-29 and 1929-30, the peak years of the movement, when over 20 per cent. of our total cows in milk were under test. Since then, however, we have steadily lost ground. In 1935-36 only 13·5 per cent. of the cows were tested, and it is necessary to go back some twelve years to find a comparable figure. Viewed in the light of the rapid increase in dairy-cow population, which, theoretically at least, should make testing all the more necessary, and remembering also the recent depression years, prospects for the future are by no means encouraging.

Important factors in connection with the dairy herd would appear to be (1) the herd sire, (2) the feed, (3) the health of the animal, though this is not necessarily the order of importance. Experience and experiment have shown that, in breeding, the sire is the over-ruling influence, and that in average crossbred herds there is not so much difference in the offspring as the result of the dam. The definite advantage of using a pedigree sire with satisfactory butterfat backing over several generations has long since been amply demonstrated. Testing-systems should therefore first provide for sufficient proven pedigree sires to enable a wide selection. Given the herd, ample and suitable feed and scientific feeding practice are essential to high and economic average production. The health of the animal takes into consideration feeding and handling, but also embraces the treatment and prevention of dairy-stock diseases, and on many farms average cow production is adversely affected by the presence of stock ailments. Herd-testing is of definite value as a guide under each of the headings mentioned, but herd-testing alone cannot result in the progress desired.

THE PAST SEASON.

As shown in Table 1, some 245,355 cows were systematically tested during the past season under one or other of the recognized herd-testing systems, this total representing a decrease of 20,589 cows, or 7·74 per cent., over the 1934–35 total of 265,944. Average butterfat-production of tested cows, however, showed an increase of 5·63 lb., being 257·64 lb. in 1935–36 as against 252·01 lb. for the preceding season. A more favourable climatic season was doubtless a predominating influence in this connection.

Table 2 relates to New Zealand's dairy-cow population from the point of view of cows in milk and dry, and covers the past ten years. For the first time in many years we have failed to record an increase, the total remaining practically the same as for 1934–35.

Table 2.—Dairy Cows in Milk and Dry as at 31st January of each Year.

Season.	Total Cows.	Cows in Milk	Dry Cows.	Percentage of Dry Cows to Total.
1926–27	1,303,225	1,181,545	121,680	9·3
1927–28	1,352,398	1,242,729	109,669	8·1
1928–29	1,371,063	1,291,204	79,859	5·8
1929–30	1,441,410	1,389,541	51,869	3·6
1930–31	1,601,633	1,499,532	102,101	6·4
1931–32	1,702,070	1,582,664	119,406	7·0
1932–33	1,845,972	1,723,913	122,059	6·6
1933–34	1,932,511	1,816,402	116,109	6·0
1934–35	1,952,094	1,827,962	124,132	6·4
1935–36	1,951,507	1,823,358	128,149	6·6

Table 3 provides a classification of tested cows according to land district, and includes a column for percentage of cows tested. It will be noted that the more important dairying districts show a falling-off, only Gisborne in the North Island and Westland and Otago in the South Island experiencing an increase, the latter in percentage of tested cows only, as the number tested is slightly lower than for the previous season.

Table 3.—Numbers of Cows tested Twice or more, and Percentages of Total Cows in Milk, classified according to Land Districts.

Land District.	1931–32.		1932–33.		1933–34.		1934–35.		1935–36.	
	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.
North Auckland	56,091	19·6	59,408	18·8	55,801	16·4	47,658	13·7	45,347	12·8
Auckland	99,806	20·6	111,517	21·1	120,982	21·3	110,107	19·0	101,565	17·2
Gisborne	9,145	20·4	10,634	19·9	12,460	21·8	12,069	20·7	13,202	26·2
Hawke's Bay ..	4,933	9·2	5,910	10·3	5,581	8·9	5,476	9·0	5,025	7·3
Taranaki	31,179	13·8	32,302	13·6	38,878	15·7	31,599	12·7	24,987	10·9
Wellington ..	30,569	13·6	34,992	14·6	38,290	15·2	38,622	15·5	36,784	14·0
North Island ..	231,723	17·6	254,763	17·8	271,992	17·8	245,531	15·9	226,910	14·6
Nelson	6,637	23·7	7,430	23·8	4,445	13·6	4,714	14·8	4,654	14·4
Marlborough ..	2,647	16·2	2,334	13·6	2,067	11·9	1,269	8·0	1,165	7·7
Westland	5,030	39·6	2,844	20·4	2,801	19·2	2,006	14·0	2,124	14·3
Canterbury ..	2,344	3·1	4,359	5·4	4,957	6·0	4,195	5·2	3,325	4·3
Otago	4,480	7·9	4,800	7·9	3,752	6·1	2,605	4·4	2,599	4·7
Southland ..	6,996	9·4	9,524	11·7	7,633	9·3	5,624	6·9	4,578	6·2
South Island ..	28,134	10·6	31,291	11·0	25,655	8·8	20,413	7·2	18,445	6·9
Dominion ..	259,857	16·4	286,054	16·6	297,647	16·4	265,944	14·5	245,355	13·5

NOTE.—" Total Cows in Milk " is at 31st January in each year.

Table 4 shows the number and size of the various organizations. The term "organization" denotes an individual unit—for example, an association operating ten groups would be included as ten, not one. A further decline in the association system is apparent. Last season the group system accounted for 94·77 per cent. of the cows tested.

Table 4.—Number of Cows, Herds, and Organizations represented in Season's Summaries received. (Basis: All Cows in Milk 100 Days or over.)

—	1933–34.	1934–35.	1935–36.
Group Testing.			
Number of groups	213	222	223
Number of herds	5,120	4,559	4,233
Number of cows	266,481	240,993	225,843
Average number of herds per group	24	20	19
Average number of cows per herd	52	53	53
Average number of cows per group	1,251	1,086	1,013
Association Testing.			
Number of associations	73	58	51
Number of herds	1,105	889	599
Number of cows	20,408	15,938	11,171
Average number of herds per association ..	15	15	12
Average number of cows per herd	18	18	19
Average number of cows per association ..	280	275	219

Table 5 is a general production summary. Figures relating to 4,832 herds are included in this table, of which 4,233 were tested under the group system and the remaining 599 under the association own-sample test. The corresponding figures for 1934 35 were 5,448 herds—4,559 group and 889 association.

Table 5.—Grand Summary of all Herd-testing Results on the Basis of all Cows in Milk 100 Days or over received for the Last Two Seasons.

	1934–35.			1935–36.		
	Number of Cows.	Days in Milk.	Butterfat-production.	Number of Cows.	Days in Milk.	Butterfat-production.
			lb.			lb.
Average for all cows ..	256,931	258	252·01	237,014	258	257·64
Average for all Group cows ..	240,993	260	253 65	225,843	259	258·62
Average for all Association cows	15,938	227	227 08	11,171	232	237·73
Highest Group average .	638	270	308 55	474	270	318·59
Lowest Group average .	856	241	194 18	1,392	206	168·90
Highest Association average	66	277	339 70	100	267	311·52
Lowest Association average .	120	201	156 15	108	191	138·92
Highest Group herd ..	20	290	484 00	6	288	517·00
Lowest Group herd .. .	10	117	80 30	11	120	53·00
Highest Association herd ..	6	278	448 00	6	264	425·44
Lowest Association herd ..	10	122	64 46	4	121	66·59
Highest Group cow	.	248	828 00		298	793·00
Highest Association cow .	..	289	777 00		339	641·00
Average daily production of butterfat for all Group cows	..		0 98			0·99
Average daily production of butterfat for all Association cows	..		1 00			1·02

In Table 6 average butterfat-production of tested cows is classified according to land district, four seasons being shown for purposes of comparison.

Table 6.—Average Production, according to Land Districts, of all Cows under Herd-test for which Seasons' Summaries were obtained.
(Basis : 100 Days or over.)

Land District.	1932–33.			1933–34.			1934–35.			1935–36.		
	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.
			lb.			lb.			lb.			lb.
North Auckland	57,771	255	245·53	54,007	250	241·11	46,037	255	243·38	43,701	250	232·96
Auckland	108,504	264	254·67	116,769	260	262·09	106,983	263	249·12	98,704	263	259·27
Gisborne	10,265	251	254·73	11,967	251	247·50	11,686	251	239·83	12,492	247	235·33
Hawke's Bay	5,595	255	263·61	5,389	253	258·75	5,300	250	247·73	4,915	254	278·35
Taranaki	31,686	265	276·19	37,790	264	286·32	30,781	267	277·88	24,243	266	273·65
Wellington	32,012	253	255·61	36,491	255	275·64	37,010	253	253·07	35,705	257	274·93
North Island ..	245,833	260	255·62	262,413	257	262·41	237,797	260	251·86	219,760	259	257·24
Nelson	7,215	239	269·27	4,322	245	272·36	4,564	251	261·61	4,378	250	276·02
Marlborough	2,151	239	249·70	1,944	228	232·63	1,204	255	264·83	1,099	255	293·61
Westland	2,816	236	260·89	2,773	241	273·17	1,997	234	270·04	2,088	238	254·68
Canterbury	4,129	223	233·38	4,449	236	255·26	3,785	216	222·35	3,011	241	272·23
Otago	4,685	238	249·02	3,568	229	264·85	2,136	241	266·40	2,209	250	273·66
Southland .. .	9,350	235	256·32	7,420	227	264·66	5,448	237	255·91	4,469	238	245·15
South Island ..	30,346	235	255·11	24,476	234	262·76	19,134	237	253·84	17,254	242	262·77
Dominion	276,179	257	255·57	286,889	255	262·44	256,931	258	252·01	237,014	258	257·64

APPRECIATION.

It is expected that this will be the last occasion on which the Dairy Division will compile the annual summary of herd-testing statistics such as has appeared in this *Journal* each year. The Herd-recording Branch of the Dairy Board will undertake this work in future. It is now some twenty-seven years since—1909—the Dairy Division founded systematic herd-testing in New Zealand. During that period it has received the unfailing courtesy and support of the various organizations connected with the herd-testing movement, and desires to record its appreciation of services rendered.

POTASH TOP-DRESSING OF AUCKLAND PASTURES.

RESPONSE FROM POTASH AT WAIHI.

J. E. BELL, Instructor of Agriculture, Pukekohe.

IN the last report* on pasture top-dressing in Auckland Province the position was summarized as follows: "Superphosphate is generally the cheapest and most efficient phosphate for pasture top-dressing, but on some soils lime is necessary to enable the best results to be obtained from superphosphate. Slag is also quite efficient, but is not superior to superphosphate or superphosphate and lime. Rock phosphates are generally inferior to superphosphate or slag. Potash responses are not frequent, and, where responses are secured, they are generally slight."

Since this was written the position as far as potash is concerned has changed somewhat, for in one district and in isolated trials in other districts distinct and payable responses occur. Nevertheless, for most parts of the province the position still obtains that the use of potash gives no response or negligible and unpayable responses as a top-dressing on grassland. Where the good potash responses are evident, the further improvement of the sward is slow unless potash is included in the top-dressing campaign, and the effectiveness of the phosphates and lime applied is very much limited. It follows that much money is being wasted in applying phosphates and lime to soils markedly deficient in potash In the Auckland Province soils are almost everywhere deficient in phosphates, and phosphatic top-dressing is most commonly practised. Lime is also deficient in about half the province, and in some districts to a marked degree.

The statement has been made that potash is a silent worker, meaning that it improves production from pastures and yet visible effects from its application to pasture are not apparent, and that it differs from phosphates and lime, from which beneficial effects can be seen to a marked degree when they are applied to phosphatic-deficient or lime-deficient soils. Agricultural works contain little information on the effect of potash on pastures—whether it has any visible effect and what that effect is. If a fertilizer could merely increase growth of the existing sward and not change its constituents or affect the grazing, the

*P. W. Smallfield, Pasture Top-dressing in Auckland Province, this *Journal*, April, 1935.

difference would be hard to detect in a grazed pasture, and a fertilizer which did this and made no other change could well be called a silent worker. However, it is impossible for a fertilizer to increase growth and not affect the composition of the sward unless that sward was at the height of perfection or contained only one plant species. Almost all swards contain many species, and if a treatment increases growth it is always to the advantage of the more vigorous and to the disadvantage of the less vigorous constituents. Potash cannot be called a silent worker, because, if it is applied to potash-deficient soils, its effects are visible. The first noticeable effect of potash is in increased clover-growth. If no clovers are present in the sward then potash can effect but little change ; but if clovers are present—they may be stunted and difficult to see—then improvement of the sward is possible. This increased clover-growth is likely to be apparent within a few weeks of application. Definite signs of improvement are not often lacking one year after application on potash-deficient soils, because there are very few swards that contain no clover. However, danthonia swards subject to much burning frequently contain no clover, and improvement of these has therefore little possibilities.

The pasture sward is a battlefield in which continual war is being fought by the different species present for existence. One of the factors which affects the fortunes of the combatants is the kind of management by stock. Some species flourish under more severe grazing than others : some dislike grazing altogether. Another factor is fertility. On grass-lands in the Auckland Province fertility is naturally poor, and is therefore an important factor. If the fertility of a soil is improved by an application of potash the soil is rendered capable of supporting the clovers present in a more vigorous state and they grow better, and in doing so they may crush out other species in the sward. As time goes on and the potash deficiency is alleviated by additional applications of potash, the clovers fight among themselves for supremacy. Slowly growing clovers are quickly subdued by ones of faster growth, and as the sward thickens annual clovers, even of the more highly productive kind, are repressed. Where conditions are suitable for its vigour a perennial species will always oust an annual one, for the weakness of the latter lies in the seedling stage. The annual has, season after season as a young seedling, to fight for a place in the sward against established vigorous perennial plants. A highly productive permanent clover with an all-the-year-round production, such as white clover, quickly assumes the ascendancy when the potash deficiency is met, providing, of course, that there are no other major physical or manurial deficiencies. White clover well established and growing vigorously improves the nitrogen-supply in the soil, and by its more continuous growth throughout the year maintains this supply better than any other clover. Nitrogen is one of the important plant-foods for the grasses of the pasture sward. Pasture-plants, for optimum growth, require a continuous large supply of nitrogen, and this is supplied more effectively by white clover than by any other clover-plant.

Potash, by inducing vigorous white - clover growth, indirectly improves the nitrogen-supply, and this improvement is reflected in increased vigour of the non-legumes in the sward. All the non-legumes in the sward are encouraged to grow at a faster rate, and competition goes on among them. The faster-growing ones suited to

FIG 1 NO POTASH (EXPERIMENT NO 306)

A sward which has received 15 cwt. of phosphate plus 5 cwt. of lime in the past five years In spite of the generous phosphatic top-dressings, the clovers are so stunted that they can only be seen by the closest examination of the photo. The presence of wild linseed and lamb's tongue indicates the poverty of the sward.

[*Photo by H Drake.*

FIG. 2. POTASH (EXPERIMENT NO 306).

This photo was taken from the potash plot alongside the plot receiving no potash, represented by the photo in Fig 1. The sward was similar to that in Fig 1 before the application of potash. The potash has made the clovers, as it were, "spring to attention."

[*Photo by H. Drake.*

the grazing conditions outstrip the other plants, and in some cases eliminate them entirely. In a reasonably well-grazed sward rye-grass, if present, assumes control, but rye-grass, not having the ability of white clover to cover the ground, does not eliminate the other grasses, as white clover through its stoloniferous growth suppresses other clovers. Thus dressings of potash finally improve a sward through distinct phases. First, increase in growth of all the clovers present, the elimination of slower-growing and of annual species, and the establishment of a thick, vigorous sole of white clover, then improvement of the pasture-grasses of higher production and the suppression of the more poorly productive ones. At the same time the weeds are greatly suppressed or eliminated by white-clover growth. Some weeds more fitted to the better growth conditions survive to a limited extent.

The aim of every farmer should be to obtain on all his pastures a vigorous sole of white clover. In potash-deficient soils this is not possible with the use of lime and phosphate, even with heavy applications. The addition of potash enables the white clover to thrive, bringing about increased grass-growth and increased production of farm-products, and will put the phosphate and lime top-dressing of the sward on a more economic footing. Even the effect of the stock-droppings are limited by the lack of potash in the soil. Stock-droppings on potash-treated plots provided a richer verdue than the droppings on plots not so treated in potash-responsive soils.

WAIHI RESPONSES.

The Waihi Plains, Ohinemuri County, do not consist of level country but comprise gently rolling downs, in area about six miles long by four miles wide. They are surrounded almost entirely by high scrub-covered or bush-clad hills. The soils are derived from volcanic-ash showers. The country is well watered by streams The soils on the rolling downs are sandy loams. Alongside the streams are small level stretches of land comprising alluvial soils of a heavier nature than the sandy loams. Small patches of the alluvial soils are covered by a small amount of peat.

On the alluvial soils the pastures are quite good and are composed mainly of rye-grass and white clover, with much sweet vernal, crested dogstail, timothy, cocksfoot, and rib-grass. On the peat areas the pasture is also quite highly productive, but contains much Yorkshire fog and some *Lotus major*. The much more prevalent sandy-loam soils have been grassed with some difficulty. The soil being light, consolidation for a grass-seed bed has been hard to accomplish, and the pastures after a few years have deteriorated to a poor type of pasture. The soils are deficient to a very large degree in phosphate, and these poor pastures have been improved to a great extent by phosphatic top-dressing. Fields on the sandy-loam soils are in various stages of development from sweet vernal, Chewings fescue, *Poa pratensis*, hair-grass, catsear, lamb's tongue, suckling clover, *Lotus major* swards to rye-grass, white-clover, cocksfoot, timothy, rib-grass swards. The pastures are generally rather poor and contain a short supply of white clover and rye-grass, and there is much *Poa pratensis*, sweet vernal, catsear, lamb's tongue, rib-grass, *Lotus major*, and suckling clover. Some fields on the three different soil types on the plains contain a fair proportion of paspalum, which grows quite well.

FIG 3 NO POTASH (EXPERIMENT NO. 306)

A top view of the sward shown in Fig 1 Here the stunted clover can be more clearly viewed Note the lamb's tongue, catsear, wild linseed, and bare ground and inferior grasses

Photo by H. Drake

FIG. 4. POTASH (EXPERIMENT NO. 306).

A top view of Fig 2. Note the increase in growth and cover of the clovers, suckling and white, and some lotus Note how the clovers have shaded the weeds, which can be scarcely seen, and also how the white clover is overtopping the suckling clover through its superior growth.

[*Photo by H. Drake.*

The climate is a wet one, the average rainfall for Waihi being 87 in. per annum, and this rainfall is evenly distributed. The winters are rather cold, with a fair amount of cold winds, but the summers are not unduly hot. The pastures are in a normal season kept well supplied with moisture and grow well throughout the summer. Supplementary crops are rarely grown, and farmers rely on hay and silage made from permanent pasture for winter feed. Successful farming, therefore, depends almost entirely on the establishment and maintenance of highly productive swards of grass.

Trials to test the value of potash and lime in the Waihi district were laid down in September, 1934. On the alluvial soils alongside streams there was no response to potash, and its use there is unwarranted. On the peat the results are not definite. On the undulating lighter country potash made the first improvement in clover-growth in the spring a few weeks after the plots were laid down. The clovers present in the sward, suckling clover, *Lotus major*, and white clover, showed improvement in growth and vigour, and the effect was so outstanding that the potash portions stood out at a distance in some trials because of the deeper green colour caused by the increased cover of the clovers of the surface of the sward. In the summer following, 1934–35, the climatic conditions were dry, and the effect from potash largely disappeared. In this, potash differs from lime, the effect from which appears more marked on clover-growth in dry summers and is not so apparent in the flush spring months. Throughout the winter following, the response from potash improved until the spring, when the responses were again marked. The following summer, 1935–36, was a wet one, and responses from potash continued to be strong. A feature of the responses in the past summer was the much better grazing of the potash-treated plots in January. The white clover is fairly quickly replacing the *Lotus major* and suckling clover, and in some of the plots these poorer-producing species have been eliminated. Where the pasture is fairly good, comprising better grasses such as rye-grass, cocksfoot, timothy, and white clover, there is not much change in the cover of the different grasses, nor is it possible, because there is little room for improvement in that direction ; but with the increase in white-clover vigour there has been a growth improvement of the grasses and a great improvement in the production of the sward. On the poorer pastures the transformation is more startling because there is more room for improvement. As the white clover assumes charge, the previously stunted and inconspicuous rye-grass grows vigorously, and poorer grasses and weeds such as hair-grass, catsear, and lamb's tongue disappear. A few of the rib-grass and weed plants more fitted to endure higher-fertility conditions under the management survive, or may increase to a limited extent. The better grasses appear more prominently in the sward because they grow taller, and in tillering occupy wider territory.

Of the six trials on the undulating sandy loam of the Waihi Plains, all have shown definite response to potash, and it appears that potash top-dressing on those soils in the locality will give payable returns.

Analyses of soil-samples have been made of the soils where the trials are being carried out at Waihi. The following table shows the results of the analyses, type of soil, and the potash response obtained for each experiment :—

Experiment.	Percentage present of Available Potash.	Potash Response	Soil Type.
16/1/299	0·018	Good ..	Sandy loam.
300	0·025	,, ..	,,
301	0·098	,, ..	,,
302	0·037	Very good ..	,,
304	0·029	Good ..	,,
306	0·018	,, ..	,,
303	0·053	Nil	Alluvial loam.
305	0·047	,, ...	,,
307	0·140	Slight ..	Peat over alluvial loam.

That there is no correlation between response to potash in the field to the potash content of the soil is quite apparent from a study of the above table. Soils from experiments 16 1/301 and 16/1/307 are extraordinarily high in available potash and yet show a response to potash. Analyses were taken from the top three inches of the soil. The only conclusion that can be assumed is that soil analysis is as yet a very poor guide to the need for potash applications to the soil.

BROWN-HEART OF SWEDES.

DRY-MATTER AND SUGAR CONTENT OF AFFECTED ROOTS.

FIELDS DIVISION

FROM some of the trials carried out with borax on the control of brown-heart in swedes, details of which were published in this *Journal* (August, 1936), at the suggestion of Mr. J. C. Neill swedes showing brown-heart infection and sound swedes were forwarded to the Dominion Analyst for examination.

The following notes are extracted from the Dominion Analyst's report on the samples submitted :—

" The swedes were sampled by cutting a section longitudinally from each root, the whole section being then pulped by passing through a mincer, and weighed portions of the pulp used for the estimation of the moisture and sugar contents. Sugars were determined chemically, the polarimetric method being unsuitable owing to the presence of reducing-sugars. The figures given for sugar in the tables of results represent the total reducing-sugars after inversion calculated as sucrose. Moisture was determined by drying to constant weight at 70° C. in an electric oven, but in some cases by the Starke and Deare process. The results show consistently that, when compared with sound swedes of the same variety, those affected with mottled-heart contain an appreciably lower percentage of sugar in all cases."

The analyses of the several roots comprising each sample have been averaged in the following table :—

Mean Dry-matter and Sugar Content of Swedes infected with Brown-heart as compared with Sound Swedes.

Origin of Samples.	Sound Swedes.		Brown-heart-infected Swedes.	
	Dry Matter.	Sugar.	Dry Matter.	Sugar.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Totara Flat, Westland	10·0	5·9	9·65	5·1
Koiterangi, Westland	12·0	6·5	10·9	5·1
Winton (Grandmaster variety) ..	8·5	4·4	8·5	3·6
Winton (Wilhelmsburger variety) ..	11·7	6·15	9·6	3·8
Stirling District, Otago	9·7	5·65	9·2	5·1
Stirling District, Otago	11·0	6·0	10·0	5·3

—*J. W. Woodcock.*

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 22nd October, 1936, to 19th November, 1936, include the following of agricultural interest :—

No. 74573 : Manure-distributor ; C R McLean No 74983 . Animal-cover ; W. Patching, Ltd No 75227 : Flax, treating , M. F Bourke. No 75365 : Gluten from wheaten flour , P S. Georgeson No. 76438 . Hoist for stacking hay ; H R. Tomkies. No. 76537 . Seed-sower , L. L. Cordery. No. 76538 : Manure-sower , L. L Cordery No 74263 . Preservation of blood ; J S Wilson. No 74602 . Manure-distributor , J Munro. No 75103 . Removing hair or wool ; O Grunwald and E E. Weiss. No 75165 . Fruits and vegetables, preservation of ; W. G Hampson No 76382 . Citrus fruit, treatment of , W C Hill. No 76528 : Butter, treating ; F. D Fogarty and J. Black No. 76581 · Cattle-drench ; C. J. F. Ratjen

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price, 1s. prepaid

There was a substantial increase, of 38,309 tons, in the deliveries of fertilizers by rail In the light of departmental investigations and experience relative to the use of fertilizers, this trend augurs well for future farm production —*Annual Report, Minister of Agriculture.*

SEASONAL NOTES.

THE FARM.

Preparation for New Pastures.

NATURALLY farmers whose results are not satisfactory seek advice relatively much more often than farmers whose results are quite satisfactory. Such advice is commonly along the lines of inspecting a poor result and of trying to provide an explanation of why the result was not better. Hence those engaged in giving advice soon accumulate considerable experience about the causes of failures. This experience tends to show that failures in the establishment of permanent pastures are due commonly to one or both of the following causes: (1) sowing too late in the autumn; (2) sowing on a rough, loose seed-bed The point of current practical interest is that both of these causes originate frequently in beginning the preparation of the seed-bed at too late a stage in the year's work.

The key to the position is the fact that the seeds of certain important pasture-plants usually included in seed-mixtures for permanent pastures are really small seeds. This is readily realized when it is borne in mind that, though rye-grass and cocksfoot are large seeds as common pasture-seeds go, they run about a quarter of a million and a half a million seeds to the pound respectively, and it is clear that when allowance is made for the seed-coat of the individual seeds, the remainder, which is the vital part of the seed and which provides the seedling, is really small Typical of smaller commonly used seeds are white clover, timothy, and *Poa trivialis*, which run about three-quarters of a million, one and a quarter million, and three million seeds to the pound respectively, while brown-top is a somewhat extreme species in that it runs about seven and a half million seeds to the pound

The size of such seeds is of practical moment, because in all cases where small seeds are to be sown it is of the utmost importance that the seed-bed be worked very fine and that preparatory cultivation result in soil that contains plenty of moisture and is well consolidated in order to facilitate movement of moisture through it from lower levels. If a seed-bed is lumpy and not firm, seeds necessarily are covered at greatly varying depths, and hence if some of the seeds are covered to a suitable depth others must be covered either too deeply or not deeply enough As good pasture-seed is somewhat expensive, it is as a rule not used in excessive amounts, and consequently loose or lumpy seed-beds are likely to lead to pastures which are too thin right from their initial stages. Even when possible, it is seldom easy to correct such a weakness.

The necessary fineness and firmness of seed-bed is obtained by judicious use of cultivators, harrows, &c., but an important part of the preparation precedes such work—when the initial ploughing is carried out. Ordinarily, in ploughing, an air-space is left beneath the furrows, and hence, until the furrows are broken down, the upper layers of soil are partly at least cut off from their supply of moisture from the subsoil. Further, the development of the root-system tends to be hampered by air-spaces. Natural weathering, which calls for the lapse of time, is the most effective and economical factor in the removal of such air-spaces, and if the ploughing is done early enough a good seed-bed will be available at the time of sowing, whereas very poor results may follow late ploughing, especially in a dry year

Late sowing of seed leads to poor establishment of pastures more often than many realize. This arises from the fact that the poor results following late sowing frequently are overlooked, because late sowing seldom leads to a complete failure. In many districts some danger is attached to sowings later than March. At times, because of unusually mild seasons, sowings

which would be too late in the majority of seasons are quite successful, and because of this similar late sowings are made commonly, and many of the poor results that ensue usually are attributed to all possible causes except the real cause, which is the bad management involved in such late sowings. It is of particular importance that clovers are especially likely to suffer in late sowings. It has also been well demonstrated that the development of rye-grass and other pasture-plants in late sowings is at times subjected to great checks from which it often seems probable that the resultant sward never recovers fully; this is mainly because of the good initial footing secured by inferior plants.

If the pasture is to be sown after an arable crop, it is often good practice, especially on reasonably clean land, to disk rather than to plough: the greater firmness of the seed-bed given by the disking is likely to be an advantage, and the additional fertility provided by the animal manure in fed-off crops is kept near the surface, where it most readily benefits the young pasture-plants.

Avoidance of Faults in Seed-mixtures.

The seed-mixtures used are often faulty; sometimes unsuitable species are included or suitable species are left out; sometimes all suitable species are included but the amounts of each used give rise to a weakness, sometimes suitable species are used in suitable amounts but poor strains of some are employed whereas much superior strains are readily available; and, finally, the seed-mixture sometimes is suitable in all respects except that the seed is of poor germination capacity or purity: neglect in regard to this point, of course, means that proper care relative to other matters is largely nullified All of which goes to show that the obtaining of suitable seed-mixtures is not a simple task - that it is a task for which time may be required to enable proper attention to be given to some of the matters calling for consideration, and hence that the purchase of seed-mixtures should not be made in the hurried manner which it may become necessary to follow when the task is deferred until just before the seed is to be sown and when there may be not enough time to obtain satisfactorily complete information about the lines of seed available. In the buying of seed it is of importance not to overlook, as so many seem to do, that the price or the appearance of seed does not at all reliably indicate its true value By utilizing the services of the Department of Agriculture much information can be obtained free of cost about the true value of seeds, just as information can be obtained about seed-mixtures suitable for particular conditions and purposes.

Any weakness which develops in a permanent pasture at the outset because of the seed-mixture or the time of sowing is likely to persist through the life of the pasture, or to be eliminated only as the result of considerable expense. Incidentally, the introduction of certified seed intensifies this position, and so makes it more advisable even than previously to proceed correctly in establishing permanent pastures.

General Pasture Work.

Unless pastures from which hay or silage has been saved have been top-dressed recently and fairly liberally they may be expected to give profitable returns, as a rule, from a dressing of superphosphate applied as soon as the hay or silage has been saved Such top-dressing is likely to be valuable regardless of the stage of growth at which the pastures were mown; pastures mown at the leafy stage usually give greater direct returns because they develop more vigorous aftermaths than similar ones mown at in later relatively stemmy or rank condition, but the latter often are weakened and in greater need of the strengthening given by the suggested top-dressing.

Apart from areas for specialized production, the production of seed by permanent pastures during their first year should be avoided. Seed-production by such young pastures is likely to lead to injury which may result in permanent stunting of quite valuable, more slowly developing species. When young pastures cannot be controlled adequately by the stock available, topping with a mower may be advisable.

Occasionally it proves advantageous to allow thinned deteriorated pastures to run to seed during the summer provided such pastures contain effective numbers of useful plants the increase of which in the sward by reseeding would be an improvement. If such reseeding takes place, it should be followed by thorough harrowing of the sward in the autumn when rain sufficient to bring about safe germination of the shed seed may be expected. However, it is well to bear in mind that if the species it is desired to increase in numbers have decreased because of a level of fertility insufficient to give them vigour enough to withstand the competition of species of lower fertility requirements, then reseeding will fail to give them a permanently increased place in the sward unless a suitable standard of fertility is maintained by top-dressing or other appropriate practices.

General Cropping work.

Although sowing of lucerne in November or December generally is preferable, in many districts, when the occasion has arisen, it has been sown successfully in January.

A matter sometimes neglected is the cutting of cereals at the most suitable stage of ripeness. Investigation has shown that the best stage at which to cut wheat generally is when the green colour has been replaced by yellow in the section of the stem between the top knot and the head of about 99 per cent. of the straws. At this stage all knots are still green and no dough can be squeezed from the grain, which, however, is still soft enough to cut with the thumb nail.

The best time to cut oats depends to a large extent upon the use to which the crop is to be put. When value is attached to the straw for feeding purposes the crop should be cut early. This is when there is just a shade of yellow over the field ; at this stage the food materials have not passed as extensively as later out of the leaves and shoots, and the nutritive value of the crop as a whole is higher than later when it has become more woody. As the result of early cutting the grain does not develop fully and is of lower weight and quality The best time to cut oats for general purposes is when the crop has developed a uniform yellowish appearance and before its final touch of green has disappeared The grain will then be able to mature in the stook and there is little risk of loss during harvesting.

Barley should be allowed to become dead ripe before it is cut. At this stage the straw is practically dry, the grains are hard, and the ears tend to bend over.

Potatoes usually repay considerable attention at this season : hoeing, weeding, and moulding up generally are necessary, and often spraying for late or Irish blight (*Phytophthora*) would prove profitable. Especially in districts in which late blight has been severe in the past, spraying usually proves fully satisfactory only when used to prevent instead of to destroy attacks of blight, which is somewhat difficult to keep fully in check once it has obtained a footing : this is especially so when warm moist conditions prevail. Spraying not carried out correctly may prove ineffective or may damage the crop Detailed information about the correct procedure in spraying is obtainable on application to the Fields Division.

Special Forage Crops.

Turnips and swedes which are still to be sown in the New Year should be sown with as little delay as possible. Hardy Green Globe is suitable for

January sowing. After the middle of January in most places it is safer to sow turnips than swedes, because the turnips develop more rapidly and do not suffer so readily or severely as swedes may suffer from insect pests in summer and autumn. Both swedes and turnips usually respond well to a dressing of fertilizer of which superphosphate is a prominent ingredient: 2 cwt. to 3 cwt. an acre is widely favoured in districts of good rainfall, while a dressing of about half this amount is favoured in districts of relatively poor rainfall.

There is still time in January to make additional provision, if it is considered likely to be needed, for a supply of feed for winter and early-spring use. A suitable crop is temporary pasture consisting of 25 lb. to 30 lb. of Italian or Western Wolths rye-grass and 5 lb. to 6 lb. of red clover to the acre sown in late summer or early autumn. To enable this crop to contribute substantially to the supply of winter feed, which usually is a main objective, it must be sown early, and many disappointments have resulted from late sowings. This is particularly true of the South Island, and true also of cereal crops sown in the fall of the year for use as catch-crops giving winter feed. A temporary pasture can be counted upon usually to yield a heavy hay or silage crop in the following summer.

Autumn-sown cereal crops to be used as catch-crops giving winter feed are of value when the land available for late-summer or autumn sowing is required in the following spring for another crop such as a root crop. Either oats or barley, both of which are sown at the rate of about 2½ to 3 or more bushels an acre, may be used. In a trial at Massey Agricultural College of crops sown on 6th March black skinless barley excelled in respect to quick production of green feed, but was inferior to Algerian oats for production of winter feed—*i.e.*, growth during June, July, and August—while Cape barley was not outstanding in any respect, being inferior to the others in growth prior to June and approximately equal to black skinless in June to August growth. Autumn-sown cereal catch-crops after turnips or after another cereal crop at times may be sown with good results with a very small amount of preparatory cultivation; disking may give sufficient tilth for the seed-bed required. With such crops a dressing of 1 cwt. to 3 cwt. an acre of superphosphate usually is profitable; it may be expected to increase both the rate and the amount of growth.

Summer Cultivation of Great Value.

Frequent and striking demonstration has been provided in the field of the fact that, unless associated with adequate cultivation, the liberal use of suitable and expensive fertilizer and the sowing of adequate quantities of the best seed available are both together likely to give unsatisfactory results. This is especially true in respect to dry districts or dry seasons, and attention to it is of basic importance in that large portion of New Zealand characterized by an annual rainfall of not more than 35 in. The great importance of the suppression of weeds in summer arises partly from the substantial way in which weeds rob crops of their supply of moisture from the soil. From these facts may be deduced the great value of keeping free from weeds those crops, such as mangels, potatoes, and carrots, sown in rows wide enough apart to allow of suppression of weeds by cultivation subsequent to seed-sowing.

Utilization of Special Summer Feed.

The use of special summer feed grown to supplement the pastures is often not commenced early enough. The influence on the value of the total production of the stock instead of the total yield in weight of the crop should be the primary consideration in using special crops. If special crops are considered on this basis it readily may be found, for instance, in dairying that a crop of turnips of 20 tons an acre used early in the New Year when urgently needed because of lack of other supplies of highly digestible

feed is more valuable than a crop of turnips of 30 tons an acre available later on when other highly digestible feed is also available in amounts sufficient for the current needs of the stock. In important dairying areas the supply of highly digestible feed directly available from pastures is inadequate on many farms from shortly after Christmas onwards for several weeks.

It should be remembered that stemmy feed which often is so abundant in summer is far from ideal from young developing stock. Such stock for their proper and economic development require abundant supplies of highly digestible feed rich in bone-forming and flesh-forming materials, and in all these respects stemmy feed contrasts adversely with leafy feed.

Normally young lucerne sown in November or December should be left unmown as long as is practicable in order to foster the development of a large and strong root-system, which is likely to be of great value in subsequent competition with invading plants. But if young lucerne is being seriously out-grown by weeds, it probably will prove advantageous to mow it towards the end of January.

—R P Connell, Fields Division, Palmerston North.

THE ORCHARD.

Cultivation.

CULTIVATION should continue to receive special attention so as to prevent the excessive evaporation of soil moisture and to prevent the forming of a crust on the surface of the soil. All grass and weeds should be removed from around the base of the tree. When the soil is infested with a twitch-grass, this should be lightly skimmed off and thrown into the centre between the rows of fruit-trees, where it can more easily be treated by the cultivating-implements. Where the trees have been treated in this manner it is advisable to replace a few shovelfuls of soil to prevent the roots becoming bare. Although this necessitates extra work in an orchard, the orchardist receives great benefit, owing to the fact that weeds, grass, &c. when left undisturbed prevent scattered showers, which usually fall in the summer-time, from getting into the soil In addition to this, weeds, when left, prevent aeration of the soil and form an ideal place for breeding of pests and diseases.

Thinning.

Where thinning has not already been completed, stone-fruit growers should proceed without delay to thin out sufficiently to give the remaining fruits ample opportunity for proper development Growers of pome fruits, too, often neglect this important operation The excuse freely given is that no time was available for the work, and that the expense is too heavy. Those growers who have regularly thinned their crops have proved beyond any doubt that thinning pays, and that it assists the tree to carry more regular crops.

Disbudding.

Disbudding should be regularly attended to now, and all shoots below the grafts should be removed. All superfluous shoots should be removed from the roots and trunks. Surplus and misplaced growth in the heads of the trees—particularly young trees—should now be carefully cut out or pinched back, where this has not been attended to already.

Spraying.

The continuation of spraying, as previously advised, will be necessary until at least the end of January, and in many instances a further one or two applications may be necessary for the control of the various fungous diseases

and insect pests in pome fruits. Good control of red mite is extremely important if the fruit is to be kept free from mite and their eggs, and the tree healthy. If the foliage is allowed to become bronzed in colour, due to mite infection—as unfortunately occurs only too frequently—it is logical to conclude that the foliage cannot function as it should do, and that as a result many of the buds which have set their fruit will prove to be too weak to set fruit in the following season. Sprays consisting of combinations of lime-sulphur and lead arsenate should be applied without delay after mixing in order to avoid undue deterioration and possible injury.

Stone-fruits should still receive attention by periodical applications of lime-sulphur 0·083 per cent. plus colloidal sulphur 2 lb. per 100 gallons for control of brown-rot, shot-hole, leaf-rust, &c. An application just prior to the fruit reaching maturity is of the utmost importance in the control of brown-rot.

Nicotine sulphate, 40 per cent. (1–800), should be applied where necessary for the control of green or black aphis.

If nicotine sulphate is not combined with other spraying-materials, 1½ lb. of soft-soap per 100 gallons should be added to enable the nicotine sulphate to become effective.

Leech (pear-slug) can readily be kept in control on plum, pear, cherry, and quince trees by spraying with 1½ lb. arsenate of lead plus hydrated lime 3 lb. per 100 gallons, whenever the pest makes its appearance.

Leaf-roller caterpillar on apricots, peaches, or nectarines can be kept in check by spraying with 1 per cent. of summer oil, as these trees do not tolerate arsenate of lead. When using the summer oil it is advisable not to apply the oil until at least two weeks after the application of a sulphur spray.

Export of Fruit.

The time is at hand for the making of arrangements for the supply of packing-requisites, and the estimating of the quantity of fruit intended for export.

Picking and Packing.

In the harvesting of stone-fruits it is important that every care be exercised in handling the fruits. It is also necessary that they be well graded and packed in the most attractive manner possible. The earliest-ripening varieties of apples will soon be ready for picking. The matured fruits should be selected from the trees as soon as they are ready, and sent to the market, as remunerative prices are usually obtained for these early supplies. Small and immature fruits should not on any account be picked, but should be left on the tree to mature.

Cover-crops.

The growing of cover-crops in established orchards has been proved of considerable value in maintaining the general vigor of the trees, particularly on land that is naturally deficient in humus. Leguminous crops are recommended for this purpose on account of their value in adding nitrogen to the soil. Blue lupin is extensively sown for this purpose, and is suitable for most districts.

The time for sowing cover-crops varies according to the local conditions. In the colder districts, where a long winter with severe frost is likely to check growth, it is desirable to sow early in January. In the warmer districts, where growth continues during the winter months, sowing in the latter part of February or early March is recommended. The use of 2 bushels of lupin-seeds plus 1½ cwt. of superphosphate and up to 3 cwt. of carbonate of lime per acre is advised for cover-crops.

—*B. G. Goodwin, Orchard Instructor, Christchurch.*

Citrus-culture.

By the time these notes appear the setting of the main crop of both lemons and oranges should be completed. Following the somewhat lighter pickings of the past season, the coming crop should be a good one. Favoured with a good setting, the grower sees the first indication of a reward for his labours. However, several months of careful management lie ahead before the fruit may be harvested and the realizations from its sale obtained. It is necessary nowadays to produce good-quality lemons and oranges, for competition is so keen that it appears certain that those who produce a large percentage of low-grade fruit will ultimately have to give way to the more efficient growers. It is generally admitted that the first step towards an improvement in the citrus industry is the production of increased quantities and the marketing of higher-grade fruit. There are many factors which influence the quality of citrus fruits, and, while a few of these are beyond the control of the grower, there is much that can be done to raise the grade standard of the crop.

Thrips is a pest which causes a silvery russet on the fruit, and in consequence is responsible for a considerable lowering of the grade of the affected fruits. More attention should be paid to the control of this insect. Control measures are outlined in the October notes. The present time should be suitable for an application of lime-sulphur 1–60 (polysulphide content 15 per cent.), as under ordinary circumstances an interval of about one month will have occurred since the application of Bordeaux. It should not be necessary to apply summer oil for at least another month—that is, until mid-January.

Leaf-roller caterpillar. The damage which this pest is causing is being overlooked in many groves. Oranges appear to be more subject to attack than lemons. Young orange-trees suffer through caterpillar damage to the young growth, which is often completely eaten up, and there is also a loss due to the affected fruits being blemished by superficial skin injury. Where this caterpillar is doing noticeable harm to trees and crop in a grove, arsenate of lead powder 1½ lb. to 100 gallons should be included in both the spring and autumn applications of Bordeaux.

The hot summer weather heralds the period of greatest activity of citrus scale insects.

Citrus white-wax scale (*Ceroplastes destructor*) where present should receive attention at the present time. A close watch should be kept for the emergence of the minute young scales, which at first resemble specks of brown dust. An application of summer oil, if thoroughly applied while the young are hatching freely, effects a clean-up

Citrus red scale (*Chrysomphalus aurantii*), often described as the world's worst citrus pest, if present in a grove, requires attention during the hot summer months. Its activity varies according to the weather conditions. The scale is very much more active in a hot dry summer than in a wet season. Under New Zealand conditions summer oil 1–33, provided it is applied thoroughly, is quite effective in cleaning up this pest. Spraying should not be done by the calendar when the young are hatching freely. The young scales during the " crawler " stage are more readily killed than the old ones, and the spray should be applied If there is trace of this pest in a grove, at least one application of the summer oil should be made ; while if the infection is at all extensive at least two applications should be made at an interval of approximately four weeks. The time for spraying, generally, is during the months of January, February, or March. It is advisable not to delay the application unduly. If the scales are allowed to become fully grown before they are killed they still adhere to the fruit and are difficult to remove, while the young scales which are killed fall off readily, particularly while the fruits or parts of the tree to which they are attached are growing Where

trees are so dense that complete coverage with the oil is rendered difficult, it is desirable that some pruning be done in order to make all parts of the trees accessible to the spray.

Citrus red mite (*Paratetranychus citri*) may become troublesome if a hot dry spell is experienced. This species is one of the easiest of the red mites to deal with. A heavy fall of rain has been known to effect a clean-up. However, when the mites are at all numerous and the dry weather appears likely to continue, it is advisable to apply summer oil 1–100. If not controlled this pest does considerable harm to the foliage and causes it to become a light-yellowish colour.

Borer may be active at this time of the year. Where it is found to be working in light wood, the cutting-out and burning of this should be done without hesitation. When it has gained access to valuable limbs, an attempt should be made to locate and kill the larva by the insertion of a stout piece of wire in the tunnel made by the insect. It should be remembered that when a hole about the diameter of an ordinary lead pencil is visible, this is a sign that the adult insect has emerged from the tree. It is the smaller holes with castings which indicate the presence of an active borer. Wounds made during the cutting-out of bark blotch are liable to afford easy access for the young borers, and this is one of the reasons why such wounds should receive a very careful coating of wound-dressing of the bitumen-emulsion type. This should be gone over again periodically to maintain complete coverage.

New plantings: If a prolonged spell of dry weather is experienced, it may be necessary to water trees which were planted in the spring. It should be remembered that there has not yet been sufficient time for much root-development, and if the soil is of a friable type it dries out quickly. Whether to water or not is a matter for the judgment of the grower after a study of the condition of the trees. If water is applied, it should be put on in sufficient quantity to allow of penetration well down to the lowest roots. In the past a timely watering in a dry season often has been the means of saving the trees in a newly planted citrus orchard.

—*A. R. Grainger, Orchard Instructor, Tauranga.*

POULTRY-KEEPING.

Causes of Early Moult.

WHY do so many birds of the average farm flock stop laying in December and go into an early moult? This is a question that has been asked on several occasions.

There may, of course, be several contributing causes, such as an inferior class of stock, parasitic infestation, unsuitable housing, or incorrect feeding. However, if a whole flock of birds stop laying and a large number go into a moult before the New Year, it is safe to say that the chief cause is a shortage of feed. Instances have been brought under notice where, although the birds have been given a good quantity of feed, egg-production has dropped suddenly and many birds have gone into a moult during December or early in January.

The successful poultry-farmer who has regularly culled his flock expects to get about a 60-per-cent. production from his adult birds during December, and on a general farm where fowls have a free range there is no reason why a good strain of birds should not equal that production. At times farm flocks are fed too much grain and not sufficient variety, especially during the hot summer months.

Where trouble has been experienced in the past with too many birds going into an early moult, it would be well to make a trial from now on of

giving the birds a little more feed and a greater variety of it. While a variety is suggested as desirable, care must be taken not to make any sudden change, to which laying birds do not take kindly. A slight addition, giving variety to the ration, often sharpens the birds' appetites, and, as increased food-consumption means increased egg-production, a little extra may keep a flock producing for some weeks longer, thus giving an increased profit. There are several ways of making this slight change. For instance, some farm flocks are fed an all-grain ration: in such cases it should pay to give a mash once a day in addition to the grain. A mash of two measures of pollard to one of bran and mixed in a fairly dry condition with skim-milk serves the purpose. If this is not convenient, a change may be made by soaking grain for twenty-four hours and giving a little each day in addition to the usual feed. Skim-milk to drink, as well as water, is a welcome change.

Too much grain has a tendency to cause birds, especially heavy breeds, to put on too much condition. On the other hand, a mash containing milk or meat-meal tends to promote egg-production. Again, if the grain ration consists of wheat alone, the addition of a little oats, barley, or cracked maize adds variety, although at first the birds may not take to the new grain.

Where a dry-mash system of feeding is adopted, the hoppers may be closed for a few hours and a wet mash of the same ingredients fed in troughs. Again, where only wet mash is fed, a little dry mash can be placed in the troughs at noon, or a light extra feed of wet mash can be given at noon. Where late or rather backward birds seem to be making little progress, an extra feed of wet mash often helps considerably.

As previously mentioned, any change, however slight, should be made gradually with judgment and care. the chief object is to induce the flock to eat a little more, but, naturally, to be successful all poor, weak specimens should be culled. If the moult has not started, the suggested slight addition, and a little more variety about this time, often enable more birds to pay their way.

Feeding of Turkey Chicks.

The three essentials to successful rearing of turkeys are - (1) good, healthy, well-matured breeding-stock, (2) suitable environment as regards soil and climate, and (3) proper care as regards cleanliness and feeding, especially until the poults are at least able to more or less look after themselves.

It is well to bear in mind that seldom does a person make a success of turkey-rearing who breeds from immature stock. For this reason it is never advisable to breed from first-year birds, especially hens. The breeders should be selected from the best of the two-year and older birds. It is also well to introduce fresh blood at least every three years, as stock from birds that have been too much inbred are most difficult to rear. Turkeys do best on dry and fairly high country where they can have a good free range. Damp, heavy, low-lying country is not suitable. Young turkeys are very susceptible to the ill effects of stale food. Turkey eggs may be hatched successfully in incubators and the poults reared in brooders, but in this country practically all turkeys are hatched and reared in the natural way.

Turkey hens make quite good mothers, but it is advisable to confine them with the young ones for the first ten days or so according to the weather. A good roomy coop with run attached should be provided, in which the turkey can stand erect and move about. If such conditions are not provided some of the poults are likely to get trampled to death. Where a coop has been used before, it should be thoroughly cleaned and washed out with a good strong disinfectant, care being taken to see that the disinfectant reaches all cracks and corners in order to destroy mites and disease germs. The coop with run is best placed in dry, clean ground where other poultry have not been running, and should be moved regularly, especially while the birds are confined.

As insects are liable to infest young turkeys at any time, one must be ever on the watch and fight against them. The best way is to dust the hen before she starts to sit, and again during the period of incubation—a suitable dusting-mixture can be made of equal parts of fine, dry, road dust, coal ashes, and sulphur. This should be dusted well into the feathers, especially under the wings and round the vent. The mixture, to be effective, must be very fine, so that it is drawn into the breathing tubes of the insects, thus suffocating them. If a little sweet oil is rubbed into the heads and under the wings of the young poults it will assist in keeping them from becoming infested. As young poults are susceptible to sunstroke, it is well to see that they can get protection from the direct rays of the sun. If they appear listless, slow-moving, and inclined to stagger, this indicates sunstroke, but if they have plenty of protection from the hot sun and do not seem to thrive, and constantly peep, peep, one may suspect insects, and treat them accordingly.

There are many different methods of feeding turkey chicks, and if a particular method has proved successful it is well not to change. The following method is suggested to those who may not have had success: About twenty-four hours after hatching sprinkle a little fine sand and oyster-shell chicken-grit on paper or boards on the floor of the coop, and about an hour after give a light feed of a mixture consisting of bread-crumbs and rolled oats, mixed crumbly with beaten-up raw egg. Four feeds of this mixture may be given the first feeding-day, just as much as the chicks will clean up. The mash should not be left to get stale. On the second day the same mixture should be given with the addition of a little finely cut (about the size of wheat grains) succulent green-stuff, such as dandelion-leaves, onion-tops, tender lucerne, or lettuce. On the third day some dry curds from which the whey has been squeezed and a little pollard can be added. This mixture may be fed for seven or eight days, and then an alternate feed of a good chick-grain mixture should be given. However, the curds and green food should be increased, and a little dry curds can be left for the poults to pick at. Gradually the mash is changed until it is made up of two measures of pollard and one measure each of dry curds, bran, and green stuff When the poults are about five weeks old three feeds per day are sufficient, one of grain and two of mash, the grain-mixture consisting of three parts of cracked wheat and one of cracked maize. After the first week a dish or hopper of dry mash can be left in the coop for the birds to pick at as they wish. Boiled potatoes or other vegetables can be mixed in the mash, but green feed and curds are very important items.

Clean water should be within reach at all times. Whole-milk may also be given, but great care should be taken to see that the drinking-vessels do not become sour. The young ones should always be fed in dishes or small troughs, and not on the ground. This is in order to guard against contamination. Although the poults should be protected from bad weather, they should not be pampered, but should be encouraged to roam after about ten days, provided, of course, the grass is dry.

The turkey-rearing section should be apart from the fowlyard and on clean ground. Before marketing the best should be selected and kept for future breeding stock.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Use of Queen-excluders.

THE coming month should prove the advantages to be gained by the use of excluders. In the colder districts they are of inestimable value in enabling the beekeeper to finish extracting before the hot weather has altogether departed. Generally, they should be used only during the main honey-flow. All sealed brood should be raised above the excluder, and the queen

confined in the brood-chamber or drawn-out combs. After a few days the brood in the super should be examined in case queen-cells have been started, as it is almost impossible to find brood-combs which do not contain a few eggs, and the bees often raise queen-cells on brood from which the queen has been separated. The queen continues to lay on the empty combs provided, and, as the brood in the upper story hatches, the combs become filled with honey—a great boon to the beekeeper who does not wish to extract brood-combs. By delaying the use of excluders till the main flow has started, one of their chief disadvantages—the promotion of excessive swarming—is largely obviated, as in most localities swarming stops automatically when clover blooms freely.

Extracting Operations.

By the end of December extracting should be commenced in the warmer parts of the Dominion, though farther south it may not commence till some little time later. The utensils for handling the honey should be thoroughly cleansed and scalded and set up in the position they are to occupy during the season. Everything should be tested to see that it can stand the strain of the season's work. Extracting is such high-pressure work that there is little time to stop for repairs once it commences in earnest. The uncapping-knives should be sharpened, strainers fitted with clean cheese-cloth, brakes and belts inspected, and all machinery oiled and cleaned so that matters may run smoothly during the few weeks that the main business of the apiary is in progress.

The honey may be extracted as soon as the combs are three parts capped, and the operation repeated two or three times during the season ; in fact, keeping the extractor running from the time the main flow sets in is perhaps the most satisfactory way of dealing with a honey crop, and is to be recommended where there is a possibility of thick honey being gathered. However, in clover districts, when the beekeeper possesses plenty of supers, the honey may be left in the hives till the end of the flow, and all the extracting done at one time. Although this ensures prime, well-ripened honey, it makes the handling of the crop very heavy work, and gives more trouble from robbers, which are always very much in evidence at the end of the season. In addition, in the colder districts heavily supered hives are apt to become chilled during the later part of the summer, and cold honey is much more difficult to extract than warm.

Once the honey leaves the hives it should be handled as cleanly and expeditiously as possible. Two or three zinc trays are a big help in disposing of drips, &c. One placed on the barrow which conveys the supers of combs to the honey-house, and another on the floor of the house to receive the supers prior to uncapping, saves much soiling of clothes. These trays should have small blocks or supports fastened in each corner to raise the supers a little, so that the drippings from burr combs, &c., may be drained away from the bottom edge of the supers. The trays are easily washed at the end of the day and drained dry ready for the next using. The extractor, uncapping-can and honey-tank when not in use should be kept covered with clean washing covers, and care should be taken that all bees, flies, and other extraneous things are excluded from the honey. From the peculiar nature of honey-production it is impossible to clean utensils day by day as is done with most foodstuffs, and it is imperative that honey be prevented from coming into contact with dirt and foreign substances.

Provision of Supers.

On no account should the beekeeper neglect to provide his swarms with storage-room. If the weather is normal, from ten to fifteen days after a strong swarm is hived it should be provided with a super Not only is this necessary in order to obtain a surplus, but if it is not done the newly created colony will probably swarm again. A swarm is most vigorous and usually

makes more headway than an established colony, and therefore should be encouraged by the provision of ample room. Many deplete their honey crops considerably by failing to realize the fact that early swarms particularly almost always yield a large surplus in a favourable season.

Ventilation of Hives.

Every care should be taken to provide the bees with plenty of ventilation during the height of the summer. All entrances should be enlarged to their utmost capacity, and, where the bees show a tendency to excessive fanning or clustering out, the hive should be raised from the bottom-board, and any obstruction such as weeds, grass, &c., cleared away from the entrances. Most important of all, ample room should be provided by means of supers, as the overcrowding of the hive tends to make the bees loaf if it does not produce excessive swarming.

Foul-brood.

As soon as settled weather sets in the beekeeper should examine carefully his hives for disease, and, if necessary, treat as soon as possible, so as to give his bees a chance to gather a surplus from the main flow. On no account should the operation be delayed until the bees are bringing in large quantities of the nectar that the beekeeper requires for extracting. The "shake" or McEvoy method is the only one advocated, and the combs and frames should be treated and disposed of as soon as possible after the hives are dealt with.

Queen-raising.

The beekeeper should devote all the time he can spare to the important work of replacing old and failing queens, and if his stocks are of good quality he should endeavour to raise as many queens as possible in his own yard. Cells built under the swarming impulse are splendid for this purpose, and there are many ways of artificial queen-raising which are to be recommended. All the cells to be hatched should be given to nucleus hives to care for; queen-cells are seldom a success when introduced to full colonies. As soon as the young queens are mated and laying, they should be placed in poor colonies, after killing the old queens, and their places filled by other ripe cells.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

WITH the keen demand for early crops, such as potatoes and peas, there is usually little delay in harvesting them; but with such crops as shallots, garlic, and autumn-sown onions, which ripen during the month of January, a delay sometimes occurs which is detrimental. They should be harvested as soon as ripening has fairly commenced, a precaution which is most important in humid districts. Drying and curing must be done thoroughly, especially where they are to be consigned to a distance, as in a soft condition they readily bruise and lack the appearance and keeping-quality of bright, firm bulbs. Shallots and garlic especially are best dried off under cover, as rain getting in between the sections of the bulbs is frequently the cause of fungous moulds becoming established. Cold frames, or plant-cradles with a waterproof blind, are suitable places for the purpose. After drying, these small bulbs keep their condition here best if they are "strung" on a piece of double flax and hung in a cool, well-ventilated position. They then keep firm right into the following summer—a thing they do not do if piled, or even when placed in well-ventilated cases. The shallots are specially suitable for pickling, being tender and mild. After three months or so in a good vinegar they are a popular condiment.

Land from which early potatoes are cleared should be dug, limed, and planted in celery and leeks. That from which peas and beans have been harvested may be given similar treatment and planted in cauliflower, broccoli, savoys, &c. These plantings should be done without delay in the cooler districts, and elsewhere they are usually best completed during the month of January.

Where celery is grown in trenches the early crop will be approaching full growth and ready for blanching. Any suckers and dead leaves about the base should be removed and the plants well watered; possibly it will be well also to apply a small dressing of nitrate of soda. A day or so later, when the foliage is dry, the leaves of each plant should be loosely drawn together by taking a turn round it with a line, the end of which is fastened to a stake firmly set in the ground at the end of the row. Then soil should be broken down fine and shovelled into the trench from each side until it is filled to a depth of 4 in. or 5 in. This process should be repeated at intervals of a fortnight, until earthing-up is completed. Varieties of the self-blanching type planted in a bed at about the ordinary ground-level require only to be surrounded with 12 in. boards on edge (or their equivalent) to blanch the stems satisfactorily in a period of about three weeks

Late crops of dwarf beans, peas (of an early variety), short-horn carrots, globe beet, turnips, silver beet, parsley, radish, spinach, and lettuce are now sown to maintain a varied supply during the autumn months. Where the land is dry, open the drills and water them well before sowing the seed and covering it.

It is now that the crop of late potatoes is liable to the attack of a fungous disease known as late-blight, *Phytophthora infestans*; wet, warm weather is particularly favourable to its spread. In wet, warm localities and seasons this crop should now be sprayed with Bordeaux 3-5-40—that is, 3 lb. bluestone, 5 lb. hydrated lime, and 40 gallons water (5 oz. bluestone, 8 oz. hydrated lime, 4 gallons water). The mixture should be made carefully according to the usual directions, as it then adheres well and is most effective. It should be applied as soon as it is mixed, as it loses its condition if held over, even for one day. It should be applied as a fine spray so as to cover well the under-side of the leaves, and it should be repeated at intervals of two or three weeks as necessary. Washing-soda may be used in the place of the lime in making this mixture. Under severe weather conditions a mixture at double strength may be applied.

The first appearance of this disease usually consists of dark areas on the leaves, often first at the edges, with a grey mould on the under-surface. In weather favourable to the attack, and where spraying is neglected, these infections spread and merge until the tops of the plants are destroyed and tubers near the surface become infected. Where such a development threatens, the tops should be mown off and removed and the tubers lifted for early consumption By planting the late crop rather wide between the rows and high moulding-up tuber infection is more likely to be avoided. This method is also of great assistance in repelling the attack of the potato-moth, *Phthorimaea operculella*, which is commonly prevalent in dry, warm districts and seasons during the autumn months Should moth-damage seriously threaten, the crop should be sprayed with a solution of 1¼ lb. arsenate-of-lead paste (or 10 oz. of arsenate-of-lead powder) in either 40 gallons of water, or the same quantity of Bordeaux mixture, in which case it serves a double purpose. For making 4 gallons of this spray mixture 2 oz. of paste or 1 oz. of powder is required. The arsenate is first placed in a small bowl and worked up into a cream with a little water before stirring it into the larger quantity of liquid.

The harvest of the tomato crop in the unheated glasshouse is at the peak during the month of January, with the outdoor crop commencing to ripen towards the end of the month. The crop realizes the best price if it is graded for maturity and quality. A well-managed crop can hardly go wrong

on these lines; but, with inexperienced picking, fruit which should be picked may be left over, and, although firm, may be too forward at the next picking. It is then probably either graded out and wasted, or packed, and the retailer then bears the loss of the waste, unless, as is most likely, the fact of mixed maturity is perceived in time and the wholesale price is reduced sufficiently to pay for the waste; for the market price of a case of fruit is assessed on the lowest grade it contains. Reasonable grades as regards maturity and quality consistently maintained secure for the brand a reputation which ensures a ready sale and sound prices. At this season of the year the ripening process proceeds rather quickly under transport conditions, and nice judgment is required when packing for distant markets. Many experienced growers underestimate the speed of this development when the fruit for a time is subject to the warm, close conditions incidental to transportation.

The tomato-plant, like the potato, is not as responsive to the applications of lime as are such crops as cabbage, celery, lettuce, and spinach. An experiment was recently concluded by the American Society of Horticultural Science to ascertain more exactly what were the lime-requirements of the tomato. Marglobe tomatoes were planted in a number of plots in which the hydrogen-ion concentration (acidity) ranged from 4·4 to 6·8. The smallest plants were grown on plots registering an acidity of 4·4 to 5·0, which may be described as very acid. Between 5·2 and 5·4 there was a significant increase in the weight of the plants, but they were still rather smaller than those on the less-acid soil reactions 5·5 to 5·7. The greatest average plant-weight occurred between 6·2 and 6·4; but it was not significantly greater than that obtained between 5·5 and 6·2. A significant decrease of weight occurred again on plots with reactions over 6·7. The optimum range of acidity for this crop is considered to be from 5·5 to 6·4.

The symbol pH is used to indicate the hydrogen-ion concentration. The neutral point in the scale is pH 7·2. Higher figures indicate alkalinity, the highest so far ascertained being 9·7. The figures below 7·2 indicate the degree of acidity, the lowest so far ascertained being pH 2·8. From this it will be seen the most suitable soil condition in this respect for the tomato crop is only slightly acid.

The Homestead Garden.

In planning the homestead garden nothing is more important than the shelter-trees and lawns, which form a setting for the crops and ornamental plants. Good evergeen shelter and deciduous shade trees suitably arranged are the fundamental features of a successful garden in the country, and too much consideration cannot be given them The requirements vary widely according to the quality of the land, temperatures, and rainfall. But there are some principles which should be carefully observed. For instance, the shelter-trees should not be seriously inflammable. Many a plantation of pine with gorse hedges in a district or situation which has a dry summer season has been the scene of serious tragedy. The danger is all the greater in the vicinity of a highway. In such cases a non-inflammable margin, at least, would be a desirable precaution. Neither should the shelter be too high nor too close to the buildings—a mistake which is easily made on land of good quality, especially in a warm climate. Pines, spruce, and the larger conifers are generally best suited for this purpose to the higher altitudes and second-class country. At lower levels cypress and native and exotic evergreens usually best serve the purpose. On land of moderate quality *Cupressus macrocarpa* is a useful tree; on better land *C. Lawsoniana* or *C. torulosa*, which are more refined, grow sufficiently large; while such trees as *Eucalyptus viminalis* and *E. Macarthuri* may often be included with advantage. Among native evergreens growing to a height of about 25 ft. species of *Pittosporum* and *Olearia* are excellent for shelter purposes of this kind. And by the seaside the karaka

(*Corynocarpus laevigata*) and pohutukawa (*Metrosideros tomentosa*) are often valuable. Such trees stand cutting where necessary; but it is important when planning shelter for the homestead to select the trees and arrange them in such a way that systematic trimming is rarely necessary. A great deal of labour can be avoided by doing this, and the work need not suffer in any way. It is important that the foliage on the weather margin should be close and compact, especially at the base of the shelter. On the sea-coast a hedge of coprosma often provides this satisfactorily; or on dry, light soil where a stock-proof hedge is desired the African boxthorn fulfils the purpose admirably without making work by growing strongly. Where the land is of better quality, the seedless barberry may well take its place. A shelter-belt on these lines where tall grass in hedge-bottoms and odd corners is cut about the month of December when in flower and before it dries is practically immune from the danger of fire, provides effective shelter, and forms a good background for ornamental planting.

Useful deciduous trees for providing shelter and shade only in summer are the willows and poplars where water is abundant, and, on alluvial land, the walnut. The sycamore is often useful for the purpose, and makes good growth even under poor conditions. The Spanish chestnut should receive consideration in good, well-drained positions, especially in warm, hilly country. By keeping these suggestions in mind, and studying the growth of the various trees in one's own district, shelter-planting may be planned with some success if it is done now with due consideration. Old plantations also often require attention now. In many the pine-trees are mature and are best felled and replaced by new plants. In others many gaps may be replanted, and on the windward side the margin closed by planting a hedge or evergreens of moderate height; by such means they may be maintained in an efficient state.

In the established garden seedling herbaceous perennial and biennial plants recently raised are planted out in nursery rows to grow on in readiness for planting out in a permanent position during autumn or early spring.

The herbaceous border now requires considerable attention, thinning, staking, and tying new growth. A good display depends very much on the manner in which this is done.

Towards the end of the month of January established evergreen hedges may usually be trimmed with best results.

—*W. C. Hyde, Horticulturist, Wellington.*

ESTIMATES OF THE SEASON'S LAMBING.

FOLLOWING are estimates of the current season's lambing in New Zealand computed from estimated average percentages furnished by Inspectors of Stock. Corresponding figures for the five previous years, together with the actual number of lambs tailed therein, are also given for comparison —

Year.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.	Actual Number of Lambs tailed.
		NORTH ISLAND.		
1936 ..	10,300,826	90·50	9,322,476	..
1935 ..	9,697,231	83·68	8,114,361	8,500,075
1934 ..	9,524,065	88·70	8,447,643	8,555,477
1933 ..	9,318,943	91·23	8,502,050	8,385,569
1932 ..	9,170,996	89·16	8,177,657	7,988,569
1931 ..	9,247,005	86·49	7,998,247	7,813,887
		SOUTH ISLAND.		
1936 ..	8,368,135	90·10	7,539,576	..
1935 ..	8,115,186	89·45	7,259,281	7,196,542
1934 ..	8,047,361	89·88	7,232·750	7,134,015
1933 ..	7,890,756	88·14	6,955,252	6,889,128
1932 ..	7,892,064	88·42	6,978,494	7,027,059
1931 ..	8,361,724	87·13	7,285,914	7,161,104
		DOMINION		
1936 ..	18,668,961	90·32	16,862,052	..
1935 ..	17,812,417	86·31	15,373,642	15,696,617
1934 ..	17,571,426	89·24	15,680,393	15,689,492
1933 ..	17,209,697	89·82	15,457,302	15,274,697
1932 ..	17,063,060	88·82	15,156,151	15,015,628
1931 ..	17,608,729	86·79	15,284,161	14,974,991

District Estimates.

The following table gives estimates of the current (1936) season's lambing for the several sheep districts.—

District.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.
Auckland..	2,166,423	87·61	1,898,104
Gisborne - Hawke's Bay ..	4,126,839	89·27	3,684,057
Wellington - West Coast ..	4,007,564	93·33	3,740,315
Marlborough-Nelson-Westland	818,950	78·46	643,336
Canterbury-Kaikoura ..	3,609,269	91·83	3,314,534
Otago (including Southland)..	3,939,916	90·91	3,581,706
Dominion	18,668,961	90·32	16,862,052

—*Live-stock Division.*

In zeal and enthusiasm about the future development of our pig-keeping there seems at times to be an inclination to overlook the outstanding feature of the position—this is, the immense and profitable scope for expansion there is along the line of better exploitation of the foundation material we already possess, both in the better strains of our pigs and in our knowledge, which, though imperfect in some respects, is nevertheless considerable.—*Annual Report, Director-General of Agriculture.*

WEATHER RECORDS: NOVEMBER, 1936.

Dominion Meteorological Office.

NOTES FOR NOVEMBER.

NOVEMBER proved a dull, wet, and changeable month, and consequently from the point of view of the public comfort it was an extremely disappointing one. Although there were several brief periods of cold southerly conditions, particularly on the 8th and 9th and during the last three days, northerly winds predominated and temperatures were, on the whole, on the mild side As a result, there has been a wonderful growth of grass and vegetation generally, and stock are in splendid condition The lack of sunshine, however, has kept the grass soft, and in some districts lambs have not fattened well. Frequent rainfall caused interruption in shearing, and also a certain amount of mortality amongst shorn sheep. Generally, however, the month was a favourable one for the farmer.

Rainfall.—The total rainfall was above the average over the greater part of the Dominion, only a small portion of the coastal area in the South Taranaki Bight and Greymouth reporting a deficit The greatest excess occurred in the Auckland Province, where some places experienced more than double the usual amount. Russell had 11·32 in against an average of 2·22 in, and Whangarei 10·11 in., the average being 2·81 in Some large excesses occurred also in Canterbury

Temperatures.- In spite of an excess of rain, temperatures were nearly everywhere above normal The departure in most cases was only a fraction of a degree, but in the southern half of the North Island several places registered over 2° F., and New Plymouth as much as 3° F Frosts occurred on only a few occasions, but some places experienced rather sharp ones on the mornings of the 15th and 16th. Some damage was caused to plants on the 15th in Hawke's Bay

Sunshine.—Sunshine was nearly everywhere below normal, the only one of the recording stations having an excess being Tauranga, where 215 hours were registered Napier had 228·9, Blenheim 200·9, and Masterton 205·4 hours

Pressure Systems - The first two days of November were fine under the influence of an anticyclone The only other anticyclone which brought fine weather over the Dominion as a whole was one which crossed between the 15th and 17th, the remainder usually passing too far north to benefit New Zealand

Between the 2nd and 5th a cyclone moved across northern New Zealand in conjunction with a deep westerly depression passing in the south. The former was responsible for heavy rain and some flooding in North Auckland, while the latter caused a strong north-west gale in Canterbury during the night of the 3rd

On the 8th, associated with a cyclone centred west of the Auckland Peninsula, strong south-easterly or easterly winds blew in the central provinces. Conditions were particularly boisterous in the Cook Strait area. Severe thunderstorms, accompanied by very heavy rains, occurred in Taranaki and the central parts of the North Island.

A series of depressions of the westerly type crossed the Dominion between the 11th and 14th and the 17th and 23rd, and, owing to the prevalence of north-westerly winds, rain during these two periods was confined chiefly to districts with a westerly aspect.

From the 24th to the close of the month a succession of cyclones passed from the northward over New Zealand, and widespread rain fell on most days in this period. On the 25th the central districts experienced a heavy north-west gale, a gust up to seventy-six miles per hour occurring on this day at the Kelburn Observatory, Wellington. A temporary improvement took place on the 26th, but on the last three days cold southerly winds and dull, misty, wet weather prevailed generally. The last of this series of cyclones was centred between Cook Strait and Chatham Island on the 30th.

RAINFALLS FOR NOVEMBER, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average October Fall.	Total Rainfall to Date.	Average Rainfall to Date.
North Island.						
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	8·48	13	2·25	2·75	56·94	51·68
Russell	11·32	11	4·25	2·22	92·30	47·39
Whangarei	10·11	15	3·12	2·81	68·54	57·52
Auckland	3·19	17	0·61	3·59	48·91	46·17
Hamilton	5·91	14	2·55	4·01	50·58	46·04
Rotorua	8·00	14	3·29	4·18	61·67	51·25
Kawhia	7·69	12	1·35	4·52	55·87	50·42
New Plymouth	7·85	16	2·02	4·70	58·51	55·49
Riversdale, Inglewood	11·30	18	3·32	9·12	93·65	96·69
Whangamomona	5·38	13	2·16	7·39	64·82	71·92
Hawera	5·62	13	1·50	3·78	43·66	41·96
Tairua	11·89	13	5·10	3·63	56·87	60·07
Tauranga	6·03	15	1·37	3·29	54·14	48·81
Maraehako Station, Opotiki	9·02	18	1·55	3·16	65·85	50·45
Gisborne	4·07	12	1·94	2·88	41·41	42·83
Taupo	4·53	14	1·19	3·32	46·73	40·75
Napier	3·11	11	0·98	2·02	44·84	28·14
Hastings	1·91	12	0·62	1·82	38·11	29·98
Whakarara Station	4·20	10	0·84	..	51·81	..
Taihape	4·08	16	0·83	3·40	41·64	33·46
Masterton	3·35	12	0·75	2·69	44·51	35·47
Patea	3·91	17	0·72	4·01	45·71	41·29
Wanganui	1·88	10	0·30	3·24	36·05	33·42
Foxton	2·90	13	0·58	3·20	37·33	29·87
Wellington	6·09	16	0·92	2·99	52·37	39·37
South Island.						
Westport	8·91	18	2·28	8·85	81·45	88·35
Greymouth	8·87	20	1·78	9·10	86·49	92·90
Hokitika	13·90	22	3·20	10·45	100·54	104·57
Ross	17·07	22	4·28	13·86	123·46	123·44
Arthurs Pass	16·32	21	1·98	16·11	134·58	147·80
Okuru, South Westland	19·59	19	3·35	12·60	150·00	133·50
Collingwood	9·59	16	2·46	6·90	89·93	89·19
Nelson	4·83	15	0·79	2·92	40·47	34·86
Spring Creek, Blenheim	3·03	16	0·78	2·39	34·06	28·18
Seddon	2·48	12	0·57	1·85	26·91	22·84
Hanmer Springs	8·25	15	2·35	3·46	56·75	[illegible]·29
Highfield, Waiau	7·45	11	2·41	2·52	40·20	[illegible]·64
Gore Bay	3·84	9	1·23	2·12	34·08	[illegible]·70
Christchurch	4·80	13	1·80	1·78	33·44	22·67
Timaru	4·36	13	1·70	1·95	27·93	20·26
Lambrook Station, Fairlie	4·89	10	1·23	1·93	27·28	22·30
Benmore Station, Clearburn	5·73	16	1·71	2·05	25·95	22·30
Oamaru	2·09	9	1·40	1·92	22·57	19·76
Queenstown	2·72	18	0·64	2·71	34·40	27·99
Clyde	1·35	8	0·52	1·34	13·26	13·46
Dunedin	5·07	14	2·10	3·21	42·28	33·18
Wendon	3·63	14	0·70	2·72	29·43	27·14
Balclutha	3·73	19	1·38	2·48	33·07	23·06
Invercargill	4·94	25	1·10	4·28	44·59	41·65
Puysegur Point	16·61	20	3·09	8·25	104·43	78·09
Half-moon Bay	8·22	19	2·34	5·79	58·83	53·89